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DISEASES OF THE URINARY TRACT IN INFANCY AND CHILDHOOD[1]

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IN the past decade the literature on modern urology in infancy and childhood has increased to such an extent that the only word applicable to it is "enormous." The most gratifying note to this building up of the literature is the fact that the American urologists have contributed more to this special field of study than have the urologists of any other country. The American urologist has done much significant work, too, in the development of urology, for he has contributed in large measure to the development of the small cystoscope, which makes possible an accurate study of the patients afflicted with urologic conditions. The recent introduction into our diagnostic armamentarium of intravenous urography has placed another agent in our hands that will, no doubt, be of great help in advancing the study of urologic cases.

That lesions of the urinary tract in children are easily overlooked is due to several factors. The average urologist does not see these patients frequently nor early enough, and the general practitioner, who, as a rule, is the first to see such patients and many times at the very onset of the trouble, fails very often to appreciate the problem before him, with the result that no effort is made to study accurately the clinical problem presented. Perhaps, part of this failure is due to the training of the general practitioner as a medical student. But even the pediatrician, who has the advantage of having had special training and who sees many of these patients, may be charged with being rather slow to avail himself of our modern diagnostic procedures.

Now, it is a fact that the teachings and writings of the older urologists, as well as of the older pediatricians, are devoid of references to urological lesions as we know them at present. But today urology is an exact science as is pediatrics, hence it would seem that pediatrics should keep pace with the most modern teachings of urology. Unfortunately, however, wholehearted co-operation between the general practitioner and the urologist, and what is more important, between the pediatrician and the urologist, is still lacking. The matter of co-operation—its great advantages to the patient—should be dwelt upon in our medical schools so that the student may grasp its import long before he enters the practice of medicine; and, in our large teaching hospitals, our large general hospitals, and among practitioners in their daily work outside hospitals, it should be an everrecurrent subject. Just why the lack of co-operation continues is not quite clear, especially in view of the fact that the little patient is consequently subjected to undue suffering. It would seem that the welfare of the patient should always be the first consideration.

In their recent monograph on diseases of the urinary tract in children, Beer and Hyman

[1] Mayo Foundation Lecture read by invitation at Rochester, Minnesota, November 3, 1930.

report a large series of cases based upon their experiences at Mt. Sinai Hospital in New York. Not only is the monograph a great tribute to the splendid co-operation between the pediatrician and the urologist, but it shows that in a large general hospital, diseases of the urinary tract are relatively frequent, and that by co-operation and intensive study a group of interesting cases can be found. There is no doubt in my mind that their experiences can be duplicated in many of our large hospitals as well as in our out-patient departments.

Because no one man sees a large number of these patients, reports of cases, together with the experiences of the author in dealing with them, serve a useful purpose in adding to the general fund of knowledge. Furthermore these contributions cannot but stimulate others to record their experiences. Recent articles show unmistakably that these lesions are much more common than was formerly thought to be the case. Pediatric urology offers wonderful possibilities of clarifying many extremely interesting and intricate problems not only with regard to diagnosis, but with regard to both medical and surgical treatment. As the urologist well knows, a large number of patients come to him for diagnosis and treatment who have had symptoms for several years and suffer from organic disease. These patients often have lesions which are the direct result of obstruction—lesions which cause irreparable damage.

It is impossible to include in this address the names of all the individuals who have played a rôle in the development of this new and fascinating subject. Suffice it to say that by their labors each and every one of them has helped to advance the cause which I am pleading—the dissemination of knowledge on the subject of diseases of the urinary tract in infancy and childhood.

That the published reports of these men have borne fruit is indicated by the increasing number of articles on urology, the increasing number of special departments which have been established for urology in children's hospitals, and, finally, the requests by pediatricians, ever increasing in number, for urological consultations with urologists. No more striking evidence of this keen appreciation can be mentioned than that in a recent article, by Helmholtz, on congenital abnormalities of the urinary tract in children. Helmholtz says that the pediatricians are not doing their duty so long as they continue to treat a patient with chronic pyelitis for months or even years without calling in a urologist to rule out complicating abnormalities of the urinary tract.

THE TAKING OF THE HISTORY

In the management of urological problems in infancy and childhood, it is extremely desirable to carry the patients through a well established or definite routine. First, an accurate history should be obtained not only of the present trouble but of all past illnesses. This task, of course, is at times an extremely difficult one due to the fact that the mother or nursemaid has not been very observing. Furthermore, the age of the patient precludes his being interrogated or makes it difficult for him to express in specific terms just what his symptoms are. On the other hand, careful detail, requiring extreme patience, in regard to eliciting the history, will often reward one with valuable information. For example, in one patient sent in with a diagnosis of sarcoma of the kidney, the mother stated that the tumor in the left flank varied in size, at times being small, at times large, a phenomenon not present in a malignant tumor but one that may be seen in a hydronephrosis. This case subsequently proved to be a hydronephrosis. The point I wish to emphasize is that the keen observation of the mother was a decided factor in establishing the diagnosis.

The history of disturbances in the gastro-intestinal tract is of great importance especially in cases of so-called relapsing pyelitis. To treat such patients by pelvic lavage, to allow the gastro-intestinal lesions to persist, and thus to feed colon bacilli into the kidneys does not make for great progress in clearing up the renal infection when the primary lesion is in the gastro-intestinal tract. One should not fail to delve into a history of acute infections of the throat, such as repeated attacks of tonsillitis as well as of acute coryza, conditions sometimes followed by pyelitis.

While there may be some doubt as to the causal relationship between head infections and pyelitis, still the mother's statement should be given consideration, especially when several attacks of pyelitis are preceded by head infections.

EXAMINATION

Physical examination should, of course, precede any and all instrumental examinations. A careful physical examination will often give one a definite idea of the underlying pathology. For example, the presence of a suprapubic tumor in a boy who has great difficulty in urinating, or the presence of a suprapubic tumor in a case of so-called enuresis, is a valuable piece of evidence and is obtainable in a few moments. In lesions of the kidney, such as tumors or large hydronephroses, the presence of a tumor again helps to direct our attention at once to the seat of the pathology.

Examination of urine. Before any sort of instrumental examination is undertaken, a careful study of the urine should be carried out, preferably daily examination. The presence of pus cells or red blood cells is often of great value, as is the presence of bacteria or casts. It is a well recognized clinical fact that in some cases of pyelitis, the urine may be clear early in the onset of the disease when the temperature is high; but subsequent examinations will show the presence of pus. This illustrates how important it is to make a daily urinary examination in this group of cases. In girls, the urine should always be obtained with a catheter.

Roentgen-ray examination. The next step in logical sequence is the roentgen-ray examination of the urinary tract, since this is a relatively easy and simple procedure. The presence or absence of stones, or the presence of areas of calcification in cases of renal tuberculosis may be quickly demonstrated, and bony defects such as spina bifida occulta, if present, come into view.

Estimation of residual urine. Estimation of residual urine is a relatively easy procedure to carry out and yields important information. It should be done in every case presenting a suprapubic tumor either with a history of difficult urination for a long period of time and a history of dribbling or of incontinence, or when these symptoms are lacking. It is needless to say that the estimation must be carried out under strict antiseptic and aseptic precautions. In case the tumor is very large, the suspicion being that the residual is high, the better procedure is to withdraw only part of the urine and to institute gradual decompression.

Determination of renal function. Next in order is a study of the renal function. This can be carried out by measuring the fluid intake and the fluid output, estimating the specific gravity of urine, and making a test of the output of urea. A blood chemistry examination should always be made in every case before a cystoscopic examination is made. One occasionally encounters cases in which there is present enormous dilatation of the kidney pelves and ureters with resulting atrophy of the kidney. These patients are skating on thin ice. If, for example, they have recently weathered the storm of an acute renal infection with impaired renal function, it might be better to defer the cystoscopic examination and ureteral catheterization until the renal function can be improved. The rule should always be to study carefully the kidney function before subjecting the patient to cystoscopic examination, ureteral catheterization, and pyelography. Mixed phthalein tests can also be carried out, or the use of indigocarmine may be employed in conjunction with the cystoscopic examination, so called chromocystoscopy.

Intravenous pyelography. With the introduction of uroselectan into our diagnostic armamentarium, a decided improvement has been made in the management of this group of cases. The use of this drug no doubt will simplify the clinical investigation of these little patients and will avoid subjecting at least some of them to cystoscopic examination and ureteral catheterization. The children seem to tolerate uroselectan well and in my experience we have secured excellent urograms without untoward reactions. In the cases in which the lower ureter is to be studied or to be shown especially clearly, it is necessary to drain the bladder with an

indwelling catheter. In my series of cases in which uroselectan was used, there was one case in which wrong conclusions were reached from the reading of the urograms. This case will be discussed in detail under differential diagnosis.

Cystoscopy and ureteral catheterization. The last steps in the examination are cystoscopy, ureteral catheterization, pyelography, and the bacteriological study of the separated urines as well as a very careful study of the renal function. It may be advisable in certain cases to defer pyelography for a subsequent examination.

DIFFERENTIAL DIAGNOSIS

Although in a child or infant the presence of a palpable tumor in the upper abdomen, with associated symptoms of fever and loss of weight, generally justifies the diagnosis of malignant tumor of the kidney, instances may arise in which the malignancy may be located in some other abdominal organ. While malignant tumors are rare in infants and children, it is a well known fact that malignant disease does occur in these little patients, as is shown in the recent articles dealing with malignant diseases in infancy and childhood by Bondy on "Angiosarcoma of the Liver"; by Castle on "Primary Carcinoma of the Liver"; by Downes on "Tumors of the Ovary"; by Fullerton on "Sarcoma of the Small Intestine"; by Harris on "Carcinomatous Ovarian Teratoma"; and by Mixter on "Sarcoma of the Bladder."

Intravenous pyelography with uroselectan should prove of great value in making a differential diagnosis. Great care should be exercised, however, in interpreting the films. For example, we might mention an interesting case in which malignancy of the kidney was suspected. Pyelograms were made after the injection of uroselectan.[1] On the one side a normal pyelogram was obtained but on the opposite side, that is the side with the suspected tumor, no kidney shadow was obtained. It was somewhat difficult to read these films as there was present a large, soft parts shadow made by the tumor and as an insufficient amount of uroselectan had been injected. From the evidence obtained a tentative diagnosis of malignant renal tumor might well have been made. However, in order to check the findings obtained by means of intravenous pyelography, bilateral pyelograms were made from below and this time we secured normal pyelograms. This case plainly illustrates that we cannot be too careful when interpreting intravenous pyelograms.

[1] Kretschmer and Hibbs. Surg., Gynec. & Obst., 1931, lii, 1.

CASE ILLUSTRATING IMPORTANCE OF CORRECT INTERPRETATION OF FILMS

Bilateral carcinoma of the ovaries

CASE 1. E. C., female, aged 3 years, 9 months, referred by Dr. Charles Schott, was admitted to the Children's Memorial Hospital, July 21, 1930. Two months before admission to the hospital the mother noticed that the child was extremely pale, was losing weight, ate very little, was very irritable, and the abdomen looked larger than usual. Several weeks later the mother noticed a rapid enlargement of the abdomen which was much more noticeable on the right side. There was some frequency; the child had to urinate three or four times at night. Before admission to the Children's Hospital the child had been in another hospital where an injection of uroselectan had been made; on the left side the pyelogram was normal and on the right side no kidney shadow was seen. A diagnosis of tumor of the right kidney was made. The patient was then sent to the Children's Hospital.

Physical examination disclosed a very prominent abdomen, fluid in the peritoneal cavity, a hard, fixed, nodular mass in the right side, and enlarged inguinal glands. Wassermann test gave a negative reaction. Blood examination showed red blood cells, 3,200,000; leucocytes, 8,400; hæmoglobin, 58 per cent. Blood chemistry: uric acid, 5.7; creatinine, 1.8; non-protein nitrogen, 45.7.

Urinalysis: albumin, 0; blood, 0; sugar, 0; many hyaline and a few granular casts. Cystoscopic examination was negative. The ureters were catheterized without difficulty or obstruction. The specimens of urine obtained from the right and left kidneys and bladder were negative and sterile upon culture. The pyelograms, right and left, were normal.

Diagnosis: primary ovarian tumor with metastases to the liver.

Result: the child failed very rapidly and died 10 days after admission to the hospital. Autopsy examination was made by Dr. W. G. Hibbs, whose findings were bilateral carcinoma of the ovaries.

Problems in differential diagnosis may arise in cases of appendicitis; for instance, when an appendiceal abscess is adherent to the bladder and produces bladder symptoms that predominate the clinical picture, or when in

association with bladder symptoms, blood and pus are found in the urine. In such cases it is necessary to differentiate an acute appendicitis from an acute pyelocystitis. When this extremely difficult problem presents itself, a complete urologic survey can be carried out without harm or causing much danger from the slight delay incident to a rapidly carried out cystoscopic examination, ureteral catheterization, and pyelography.

MALIGNANT TUMORS OF THE KIDNEY

As may be seen from a review of the literature, malignant tumors of the kidney are rarely found in infants and children. In a review of 4,903 autopsies, Bugbee and Woolstein reported no cases of malignant renal tumor. In an analysis of statistics relative to the incidence of kidney tumors in human beings, Hinman and Kutzman found 128 renal tumors in 47,000 adult cases, a percentage of 0.25 or 1 in 400. In 20,470 children they found 14 cases, a percentage of 0.60 or 1 in 2,500. These statistics clearly demonstrate that renal tumors are about four times as common in adults as they are in children.

Kidney tumors may be divided into three groups, based on point of origin:

1. Tumors having their origin in the renal capsule itself. Such tumors are rare.

2. Tumors of the kidney pelvis. This group is even less common than Group 1; according to Gilbert Thomas, they are less common than tumors of the parenchyma.

3. Tumors of the renal parenchyma. This group comprises the most common type of malignant renal tumor.

Some confusion still exists as to the nomenclature of kidney tumors. It is generally admitted at the present time that the most common type of tumor is the so-called mixed tumor of Wilms. In a paper in which Hibbs and I reported a study of 17 cases of Wilms tumors, it was interesting to note the various histological diagnoses that had been made; for instance, multiple cell type sarcoma, myxomatous tumor, alveolar round cell sarcoma, and myxomatous sarcoma and hypernephroma. A later histological study of these tumors showed that these diagnoses were incorrect, for the tumors so named belonged to that interesting group—the mixed tumors. Bilateral mixed tumors are rare although we found 2 in our series.

The embryonal structure of these tumors is their most distinguishing feature. Both epithelial and connective tissue elements are present; the former are composed of small and large epithelial cell nests and embryonal tubules, undifferentiated round cells, and striated and non-striated muscle fibers. Elastic tissue and fat may be present as well as cartilage and bone. Bone formation is rare, however, probably due to the fact that the patients die early and there is not sufficient time for bone formation.

Trauma probably plays a negligible rôle in the production of these tumors, although a history of trauma was given in 3 of our cases.

Beer and Hyman quote the following theories concerning the pathogenesis of these malignant tumors as mentioned by Frazer:

1. That their origin is due to inclusion of wolffian body tissue which has become displaced and persists among the cells of the developing kidney or metanephros (Birch-Hirschfeld);

2. That aberrant cells of the myotome and scleratome are responsible for the tumor growth and that the apparent mixed cell character is to be explained by the varying constituents which enter into the ultimate formation (Wilms);

3. That these tumors are not due to inclusions from extrarenal sources but are derived from the embryonic tissue of the true kidney, this tissue persisting and becoming metamorphosed into cellular structures of various types (Busse, Muns, Ewing).

Fourteen of our patients were males, and only 3 were females. In the series of Beer and Hyman 10 were males and 7 females. Two of our patients were under 6 months of age, the oldest 6½ years.

Among the general symptoms noted may be mentioned fever, abdominal pain, loss of appetite and weight, and irritability.

The one constant symptom is an enlargement of the abdomen, which is often discovered by the mother or nursemaid. When first noted the swelling is generally of large size, a fact which indicates that the tumor

has been present for some time; hence, it is exceedingly difficult to determine the duration of the patient's illness. The rate of growth of these tumors may be said to be rapid probably in most of the cases. Death is generally due to cachexia, metastases, and occasionally to intercurrent infection.

Hæmaturia so common in malignant disease in the adult is singularly uncommon in the child. In only one of our 17 cases was blood reported in the urine and there was some doubt about this. Microscopic blood was found in some of them.

Since many of these patients come in late in the course of the disease, the diagnosis is relatively easy. The presence of a large unilateral tumor, often of enormous size, which may or may not show an irregular nodular surface, which has had a more or less rapid growth, the presence of anæmia, loss of appetite and weight, all are positive signs that should safely guide us toward making a correct diagnosis. A plain roentgenogram will often reveal the outline and the extent of the tumor. The value of intravenous pyelography is evident. As a rule cystoscopy and ureteral catheterization are carried out last in the routine examination, so as to determine the presence and functional capacity of the opposite kidney, and to make bacteriological studies of the urine.

Metastases occur in the liver and in the lung. Extension metastasis may occur throughout the entire abdomen, the growth involving the viscera and completely enclosing such structures as the pancreas and suprarenals. Metastasis to the opposite kidney has been noted. Extension through the diaphragm may occur, in which case tumor nodules are found on the pleural surface of the diaphragm.

ILLUSTRATIVE CASES OF MALIGNANT TUMOR OF THE KIDNEY

Malignant tumor of the kidney

CASE 2. J. B., male, aged 1 year, was admitted to the Presbyterian Hospital, July 17, 1929, with complaint of enlargement of the abdomen and a tumor mass on the right side. Six weeks before admission to the hospital, the mother, while bathing the child, noticed this enlargement of the abdomen. There had been no pain or urinary symptoms. Physical examination was negative except for a large tumor in the right upper quadrant, which extended from the arch of the rib down to the crest of the ilium. The mass was firm, smooth, elastic, and freely movable. Blood examination showed red blood cells, 4,000,000; leucocytes, 16,200; hæmoglobin, 68 per cent. Wassermann and Kahn tests were negative. Blood chemistry: urea nitrogen, 23.4; uric acid, 5.0; creatinine, 22; total non-protein nitrogen, 41.7. Urinalysis: reaction, acid; sugar, 0; albumin, +; blood, 0; sediment, 0. Roentgen-ray examination disclosed a uniform, dense shadow over the right half of the abdomen. Cystoscopic examination disclosed a normal bladder; the urine from the left kidney negative. A left pyelogram was normal. The right pyelogram showed the ureter displaced to the left side of the abdomen. No fluid entered the kidney pelvis.

On July 21, 1929, under ether anæsthesia a right nephrectomy was done. Following the operation the child developed complete anuria. The blood chemistry was: urea nitrogen, 100; uric acid, 9.1; creatinine, 4.3; total non-protein nitrogen, 128.9. The anuria was relieved by ureteral catheter drainage. Following the removal of the catheter, the patient again developed anuria. The blood chemistry at this time showed 133 milligrams of urea nitrogen.

On July 29, 1929, a second operation was done, consisting of pyelotomy and decapsulation. The kidney was normal and free of tumor. The patient left the hospital 22 days after the operation.

On September 23, 1929, he was admitted to the hospital a second time. Two weeks prior to this the presence of a mass in the left upper quadrant had been noticed by the parents. On September 24, 1929, under ether anæsthesia a third operation was performed. At this operation was found a large malignant tumor involving the remaining kidney. Sections were removed and microscopic examination revealed the presence of mixed tumor cells that corresponded with the structure in the sections that were made from the kidney removed from the opposite side 2 months ago. The patient left the hospital, October 18, 1929. He was given deep X-ray treatments, but failed rapidly and died on December 22, 1929.

Autopsy showed the presence of a Wilms tumor in the remaining kidney.

Malignant tumor of the kidney

CASE 3. L. J. W., female, aged 13 months, was admitted to the Children's Memorial Hospital on the service of Dr. Joseph Brennemann, October 8, 1928. The parents stated that the baby had always had a very large, prominent abdomen and that this had been noticed since she was about 1 month old. No importance was attached to this enlargement until the child was 13 months old when they took her to a doctor because they believed that the abdomen was growing more rapidly than the rest of the body.

Physical examination was negative except for the presence of a large mass in the left side of the abdomen which was firm, movable, and occupied

practically the whole of the left side of the abdomen. A small nodular mass was felt just to the left of the umbilicus. Urinalysis: reaction, acid; albumin, +; sugar, o; sediment, negative. Blood examination: red blood cells, 6,330,000; leucocytes, 18,480; hæmoglobin, 60 per cent. Wassermann test was negative. Cystoscopic examination revealed a normal bladder. Urine from the right kidney was normal; no urine was obtained from the left kidney. Pyelograms were made and revealed a normal right side. On the left side, the bromide solution met an obstruction at the ureteropelvic junction, hence no pyelogram was obtained.

A left nephrectomy was done. Sections were made and showed a mixed tumor (Wilms). Since leaving the hospital the patient has had two courses of deep X-ray treatment and is still living and well.

TUBERCULOSIS OF THE KIDNEY

During infancy and childhood, chronic renal tuberculosis is rare. A study of the literature reveals this fact and I have found it to be true in my experience. I have seen but 8 cases of renal tuberculosis in children up to the age of 14 years. Five of these children were operated upon. In a series of 335 cases (operated upon), Kuster reports that 1.49 per cent occurred in children from 1 to 5 years old and in a group from 5 to 10 years old he found 1.49 per cent. Guillom reported 60 nephrectomies from the Albarran service and found 5 per cent under the age of 20. In his thesis, Boeckel published the statistics of Andre. In this series of 64 nephrectomies there were 4 cases, or 6.25 per cent, under 19 years. Wildbolz found 1.26 per cent under the age of 10 years.

I believe that there is slight doubt but that the figures on the frequency of renal tuberculosis in children will undergo revision in the near future, when all cases of chronic pyuria and so-called relapsing pyelitis will be subjected to more careful and complete urologic study. A more painstaking comprehensive urologic study will likewise throw light on another debatable point, that is whether the involvement is unilateral or bilateral.

The problem of diagnosis will not be difficult provided careful examination is made of every case of pyuria or hæmaturia as well as of every case with persistent bladder symptoms. However, one should keep uppermost in his mind the possibility of the presence of renal tuberculosis in all cases that fail to respond to medical treatment for chronic pyuria. Routine X-ray examination of the urinary tract will often show areas of calcification compatible with renal tuberculosis—a phase of the diagnosis in renal tuberculosis ably presented by Braasch some years ago.

The problem is just the same in children as it is in the adult, namely: to determine which side is involved and the functional capacity of the well side. In the early cases cystoscopic examination may show nothing abnormal. However, many patients are not seen until the condition has been present a long time so that the bladder has already become more or less involved and changes have taken place which are readily recognized by the well trained urologist, when the patient is subjected to cystoscopic examination.

It is surprising to note that many European urologists consider that it is difficult to diagnose this lesion and to determine whether or not the lesion is bilateral or unilateral. They attribute this problem to the difficulty of passing the cystoscope. Mathieu states that, under 8 or 10 years of age, catheterization very often seems impracticable, so that it is his custom to perform an exploratory operation in the lumbar region. However, with the present highly perfected small cystoscope, the field of applicability of cystoscopy and ureteral catheterization must ever widen. Even in small boys in whom only small instruments can be introduced, one is justified in some cases in catheterizing and studying one side at a time. This technical difficulty may be still further reduced by using uroselectan. Once the diagnosis of chronic unilateral renal tuberculosis has been made, provided the opposite kidney is free of tuberculous disease, a nephrectomy would be the proper course to pursue.

ILLUSTRATIVE CASES OF RENAL TUBERCULOSIS

Renal tuberculosis—right

CASE 4. F. B., female, aged 9 years, was admitted to the Presbyterian Hospital on the service of Dr. C. Grulee, October 4, 1930. For the past month the patient had been voiding small amounts of urine at frequent intervals and had been obliged to rise from four to six times at night to void. This was not associated with much pain, although at present there is some burning upon urination. Physical examination was negative except for a slight tenderness in the

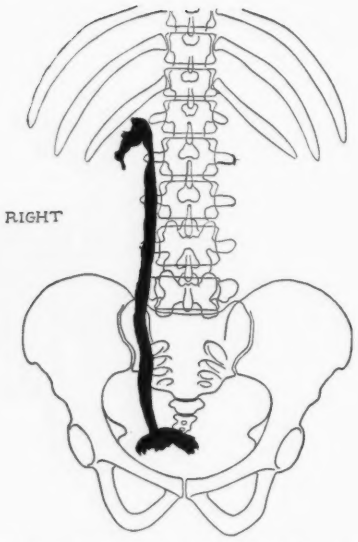

Fig. 1. Case 4. A peculiar outline of the kidney pelvis that might be confused with the deformity seen in renal tumor.

suprapubic region and to the right and left of the subcostal regions. Urinalysis showed albumin 0, blood +, pus 0, sugar 0, casts +. Blood examination showed red cells 4,480,000, leucocytes 4,250, hæmoglobin 66 per cent.

Blood chemistry tests showed urea nitrogen 17.6, uric acid 4.3, creatinine 1.4, non-protein nitrogen 26.5. Blood Wassermann test was negative.

Cystoscopic examination revealed a few spots of ulceration in the region of the right ureter but the bladder was otherwise negative. The ureters were catheterized without difficulty or obstruction. Examination of urine obtained at that time showed:

	Leucocytes per c.mm.	Cultures	Tubercle bacilli	Guinea-pig inoculation for tuberculosis
Bladder	12	Sterile	0	0
Right kidney	70	Sterile	+	0
Left kidney	220	Sterile	0	0

Pyelograms were made and showed on the right side (Fig. 1, Case 4) the kidney pelvis, irregular in shape, opposite the second lumbar vertebra, the superior calyx was narrow, and the margins were ragged. The upper ureter was within normal limits. The left pyelogram showed a normal pelvis.

Roentgen-ray examination of the chest disclosed a circumscribed area of increased density over the left side of the heart.

Fluoroscopic examination of the chest disclosed a density within the lung indicating the presence of a tuberculous abscess. Patient was sent to a tuberculosis sanitarium.

Renal tuberculosis (right) and pulmonary tuberculosis

CASE 5. O. T., colored female, aged 7 years, was admitted to the Presbyterian Hospital, on the service of Dr. C. Grulee, February 15, 1928. The patient had been suffering from frequency of urination, nocturia, hæmaturia, and dysuria for some weeks. These conditions had not been noticed until the child had wet the bed a number of times and had complained of pain on urination. During the past 3 weeks the symptoms had become more marked. There had been a discharge from the right ear for 4 years. Physical examination was negative except for a purulent discharge from the right ear, marked cervical adenopathy on the right side, and small glands on the left. Urinalysis disclosed albumin +, sugar 0, blood +, casts +, pus+. Blood examination showed red cells 5,460,000, leucocytes 7,300, hæmoglobin 72 per cent.

Roentgen-ray examination of the chest showed tuberculosis. Roentgen-ray examination of the kidneys was negative for stone.

Cystoscopic examination revealed the presence of cystitis. The left ureter was catheterized without difficulty or obstruction and very purulent urine was obtained. The right ureter was catheterized, but urine was obtained with great difficulty and on examination showed:

	Leucocytes per c.mm.	Cultures	Tubercle bacilli	Guinea-pig inoculation for tuberculosis
Bladder	4560	Sterile	+	+
Right kidney	2	Sterile	0	0
Left kidney	2320	Sterile	+	+

Von Pirquet test gave a positive reaction. The right pyelogram was normal.

On March 2, 1928, under ethylene anæsthesia, a left nephrectomy was done. The ureter was found to be slightly thickened, the kidney much enlarged, with large tuberculous nodules on its surface. One tuberculous mass was as large as a plum.

Result: uneventful recovery. Discharged from the hospital, March 26, 1928.

Bilateral renal tuberculosis

CASE 6. R. W., male, aged 14 years, was admitted to the Presbyterian Hospital, September 24, 1923. The previous history was negative. Nine months before admission to the hospital, while ice skating, patient's feet got wet, after which he urinated every hour during the day for 3 weeks. The frequency varied and during the past 4 months he has been obliged to void every 2 hours. Urination was painful, especially at the end of urination, and was associated with a pressing sensation and a sensation of great straining. For the past 2 months, blood has been noted in the urine at the end of the act. Physical examination was negative. Blood examination revealed red cells 5,180,000, leucocytes 10,600, hæmoglobin 90 per cent. Blood pressure: systolic 118; diastolic 72.

Fig. 2. Case 6. Areas of calcification between first and second lumbar vertebra.

Roentgen-ray examination disclosed a group of small, dense shadows at the second lumbar on the left side, cast by calcified glands.

Cystoscopic examination showed areas of superficial ulceration of the bladder. The ureters were catheterized without difficulty or obstruction. Examination of the urine obtained at that time showed:

	Leucocytes per c.mm.	Cultures	Tubercle bacilli	Guinea-pig inoculation for tuberculosis
Bladder	390	Sterile	0	Positive
Right kidney	80	Sterile	0	Positive
Left kidney	570	Sterile	+	Positive

Pyelogram of right side showed a normal pelvis. On the left side the pyelogram (Fig. 2, Case 6) showed a group of calcified glands in the middle of the kidney pelvis.

Result: no operation, patient died May 16, 1927.

URINARY CALCULI

Calculi in the urinary tract, it is believed, are relatively rare; at least the number of cases reported is small. This supposedly rare incidence may be due to failure to recognize the stone, since careful routine examinations in these little patients are not made for stone. It is possible that, because of prominence of the gastro-intestinal symptoms, instances may be overlooked, the patients being regarded as gastro-intestinal cases. If, because calculus

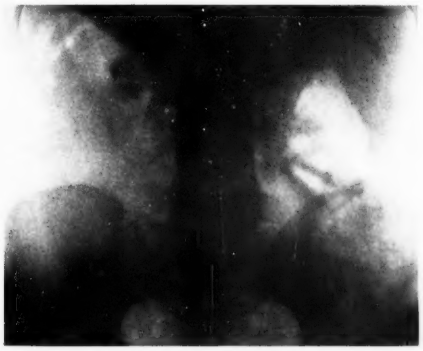

Fig. 3. Case 7. The presence of stone in the right kidney.

disease is suspected, careful routine examination of the urine is carried out, changes in the urine would be found that would call attention to the possibility of a lesion in the urinary tract. In such case a complete urological study should be made to verify the diagnosis.

Thomas and Tanner in an article based on a questionnaire were able to collect 203 reports of urinary lithiasis in infants and children. The average age was 7.8 years. Forty of the total number occurred in children up to the age of 5 years; 60, in children between 5 and 10 years; and 58 between 10 and 15 years. In the 45 remaining cases the age was not given. There were 155 males and 45 females, or a ratio of about 3 to 1. They found the following localization:

	Patients	Per Cent
Right kidney	21	10
Left kidney	8	3.9
Right ureter	7	3.4
Left ureter	8	3.9
Bladder	116	57
Urethra	25	12
One kidney and one ureter	9	4
Both kidneys	14	6
Both ureters	1	....
Both kidneys and ureters	1	....

Thomson reported a series of 585 cases of calculi of the urinary organs in which operation was performed. Thirty-eight per cent of the cases were children under 15 years of age, figures that no doubt are much higher than those in this country.[1]

Clinton Smith found 5 cases—a relatively high incidence—in his series of 56 cases in

[1] Report on Urinary Calculus, Canton Hospital, Canton, China.

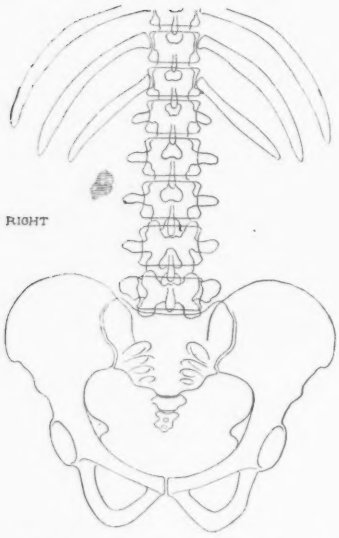

Fig. 4. Case 8. A solitary stone in the right kidney.

which complete urological study was made for symptoms relative to the urinary tract.

In children the stone is found in the bladder in the great majority of cases. Bokay found the stone in the bladder in 1,150 out of 1,621 cases of urinary calculi in children (Thomson-Walker).

Regarding the incidence of lithiasis in children, Hager presents some very interesting data. In a series of 3,295 cases of children under 15 years, he found bladder stones in 11 of 674, or 1.63 per cent; ureteral stones in 7 of 813, or .86 per cent; and kidney stones in 15 of 1,808, which is a relatively low incidence.

In the average case of kidney and ureteral stone the syndrome tallies closely with the picture presented by the adult, except that it is often difficult to obtain a classical history in children, and, also, because of the presence of gastro-intestinal symptoms, the urological symptoms are overshadowed, hence, overlooked. But repeated examinations of urine for the presence of blood cells and pus cells, as well as crystals, will give a clue to the real cause of the symptoms, and this should be an incentive to careful urological study.

Pain is present in by far the largest number of cases. Renal colic and blood and pus in the urine occur with renal and ureteral stone. In one child the only complaint was painless hæmaturia and yet examination disclosed calculi on both sides. In another instance, the patient was sent in because albumin had been found in the urine. A diagnosis of nephritis had previously been made.

Calculi in the bladder of the child produce symptoms similar to those in the disease in the adult, namely: pain, frequency, urgency, and tenesmus. At times there is a great urgency and great difficulty is experienced in holding the urine with the result that the child wets the bed at night and his clothes during the day. On account of these symptoms a diagnosis of enuresis is occasionally erroneously made, and the usual treatment for enuresis is instituted with the result that one more patient is added to the list of failures to relive the condition treated. In every case of enuresis, we always make it a rule to subject the patient to an X-ray examination of the genito-urinary tract and to a cystoscopic examination. We do this especially in that group which have been treated for enuresis for varying periods of time without relief.

The diagnosis and differential diagnosis should offer no problems not met with in the adult.

ILLUSTRATIVE CASES OF CALCULUS

Renal calculus

CASE 7. E. H., female, aged 10 years, was admitted to the Children's Memorial Hospital, on the service of Drs. Fiske, Helmholz, and Schott, March 2, 1920. Eight months prior to admission to the hospital, patient had had attacks of severe pain on the left side of the abdomen. The pain was aggravated by movement or exertion. At times these attacks occurred every day. No urinary symptoms were present. Physical examination was negative. Cystoscopic examination revealed a normal bladder. The ureters were catheterized without difficulty or obstruction. The urines from the right and left kidneys were free of pus and sterile upon culture; the bladder urine showed 112 pus cells per cubic millimeter but was sterile upon culture. Roentgen-ray examination disclosed a stone, in the left kidney, about the size of a dime (Fig. 3). Permission to operate was refused.

Renal calculus—right

CASE 8. M. M., female, aged 9 years, was admitted to the Children's Memorial Hospital, on the service of Dr. Aldrich, February 2, 1928, with complaint of frequency and painful urination. Patient

Fig. 5. Case 9. The presence of bilateral renal calculi. Note the light center in each stone.

had been under treatment in the out-patient department for the presence of pus in the urine. Physical examination was negative. Urinalysis showed albumin, ++++; blood, 0; sugar, 0. Microscopic examination showed many pus cells, both free and in clumps. Cultures showed colon bacilli. Roentgen-ray examination (Fig. 4) revealed a shadow in the region of the pelvis of the right kidney.

Cystoscopic examination disclosed large flakes of pus adhering to the bladder mucous membrane. The ureters catheterized without difficulty or obstruction. Examination of the urine obtained at that time showed normal urine from the left kidney, and 3,000 leucocytes and colon bacilli on culture from the right kidney. Blood chemistry showed normal blood. Under ether anæsthesia a right pyelotomy was done March 29, 1928. A large stone was removed through the incision in the pelvis. A small aberrant vessel was found running to the lower pole of the kidney. Convalescence was uneventful and patient was discharged from the hospital, April 19, 1928.

Bilateral renal calculi

CASE 9. E. S., female, aged 12 years, was admitted to the Children's Memorial Hospital, August 13, 1929. Three years ago patient had a severe attack of pain in the right lower quadrant. The pain was severe, and the attacks have increased in frequency and severity. Urination sometimes relieved the patient. The attacks were associated with chills, fever, and vomiting, and at times by frequency of urination. Physical examination was negative. Urinalysis showed reaction, acid; albumin, ++; sugar, 0; pus, ++. Blood chemistry showed normal blood. Cystoscopic examination showed the bladder to be normal. The ureters were catheterized without difficulty or obstruction. Examination of urine obtained at that time showed:

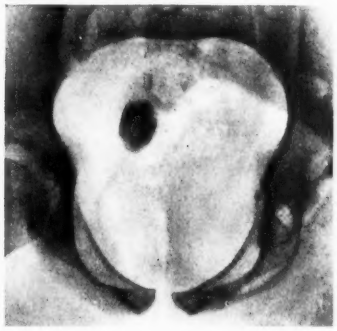

Fig. 6. Case 10. The presence of a large stone in the left ureter.

	Leucocytes per c.mm.	Cultures
Right kidney	2,080	Staphylococcus albus
Left kidney	810	Staphylococcus albus

Roentgen-ray examination (Fig. 5) revealed bilateral renal calculi. Under ether anæsthesia, on August 22, 1929, a bilateral pyelotomy with removal of the stones and decapsulation was done. Chemical examination of stones showed uric acid.

Convalescence was uneventful; patient was discharged from the hospital, September 6, 1929.

Left ureteral stone

CASE 10. W. A., male, aged 11 years. A previous urinary examination showed a large amount of pus. There were no urinary symptoms. Physical examination was negative. Blood examination showed: red blood cells 5,168,000; leucocytes 26,000; hæmoglobin 95 per cent. The Wassermann test gave a negative reaction. Urinalysis showed reaction acid; albumin 0; blood 0; sugar 0; pus ++; tubercle bacilli 0. Roentgen-ray examination showed a shadow extending from the second sacral foramen to the end of the sacrum (Fig. 6). Cystoscopic examination revealed a normal bladder. A thick worm-like cast of pus was seen protruding from the left ureteral orifice. The right side was catheterized without difficulty or obstruction and the urine obtained was clear and sterile upon culture. On April 7, 1923, under gas-ether anæsthesia, a left ureterotomy was done. The ureter was found to be thickened, hard, and fibrous. Stone was removed. Recovery uneventful.

Stone in ureter—right

CASE 11. N. N., female, aged 8 years, was admitted to the Presbyterian Hospital, December 17, 1926. During the past year she had had severe attacks of pain in the right kidney region, radiating downward and forward into the bladder. The attacks usually lasted about 3 to 12 hours, and were associated with pain, nausea, and vomiting. The present attack had begun 4 days before admission to

Fig. 7. Case 11. The presence of a stone in the right ureter.

the hospital and the pain was still present. The pain generally subsided gradually and was followed by soreness in the right side. The attacks were brought on by riding on street cars and buses. Blood was found in the urine about 6 months ago.

Physical examination was negative except for some tenderness on the right side in the region of the right kidney. Urinalysis showed albumin, +; sugar, o; blood, trace; sediment showed pus cells and many red blood cells. Blood examination showed red blood cells 5,510,000, leucocytes 17,200. Roentgen-ray examination disclosed, low on the right side of the pelvis, a dense shadow (Fig. 7) strongly suggesting a stone in the ureter. Cystoscopic examination revealed the right ureteral orifice swollen and œdematous. The ureters were catheterized with some difficulty on the right side. Examination of urine obtained at that time showed no pus cells, no organisms on smear, and sterile upon culture. A further roentgen-ray examination (Fig. 8) showed the presence of stone in contact with the shadowgraph catheter. A shift plate film showed the stone still in contact with the catheter and a dilated pelvis. A diagnosis was made of stone in the right ureter. On December 16, 1926, under ethylene ether anæsthesia. a right ureterotomy was done. Recovery uneventful and patient was discharged from the hospital, January 21, 1927.

Bladder calculus and fibrosis of internal urethral orifice

CASE 12. H. H., male, colored, aged 9 years, entered the Children's Memorial Hospital, September

Fig. 8. Case 11. Dilatation of the ureter and pelvis above with the stone.

10, 1929. Patient had been suffering for 1 year with constant dribbling of urine associated with burning on urination. There had been difficulty in passing urine necessitating great straining for some length of time. Physical examination was negative except for the presence of a large suprapubic tumor. The Wassermann test gave positive reaction. Cystoscopic examination revealed a stone, as well as œdema, and redness at the base of the bladder. The residual urine was 8 ounces. A diagnosis was made of stone in the bladder, chronic cystitis, and fibrosis of internal urethral orifice. Operation was advised and consented to. A suprapubic cystotomy was made and the stone was removed. The internal urethral orifice was resected and the posterior urethra dilated with the finger. Patient made an uneventful recovery.

ACUTE AND CHRONIC INFECTIONS OF THE KIDNEY

It is a generally well recognized fact among pediatricians and urologists that the disease most frequently found in the urinary tract of infants and children is that presenting the clinical picture of pyelitis or cystopyelitis. That this clinical picture is frequently present

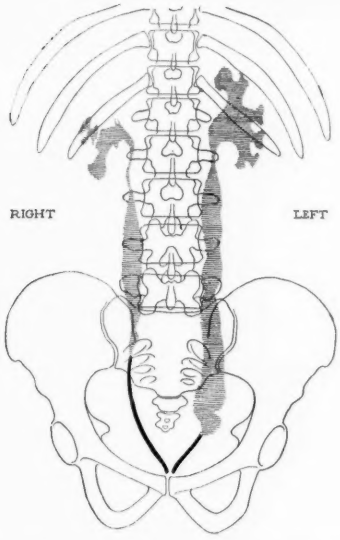

Fig. 9. Case 15. Bilateral dilatation of ureters and kidney pelves.

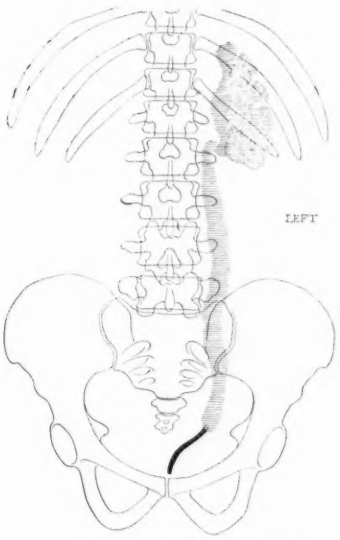

Fig. 10. Case 17. (Left pyelogram.) The presence of enormous dilatation of the kidney pelvis and ureter.

is proved by a study of the statistics of children's hospitals, of the pediatric services of the large general hospitals, and also of large out-patient departments. The experience of various urologists as shown in their published reports also confirms this finding. Thomas and Birdsall found 14 cases (34 per cent.) of pyelitis and pyelonephritis in a series of 48 renal lesions. Their figures closely resemble my own; in a previous paper I reported that in a series of 86 cases of urologic conditions in children, a diagnosis of pyelitis and pyelonephritis was made in 30, or approximately in 34.5 per cent.

The fact that these infections are so frequent and the fact that the various methods of treatment have given unsatisfactory results probably account for the extensive literature on the treatment of pyelitis.

The failure to effect cure through the various forms of treatment that have been and are still in use is due to the fact that the underlying pathology is not understood; for the diagnosis is generally based on the symptoms, especially on the presence of pus in the urine.

As a result of intensive study, the old conception of the clinical picture of so-called pyelitis has completely changed, and we are now in a position to appreciate why in one group of cases the disease runs an apparently self-limited course and responds promptly to

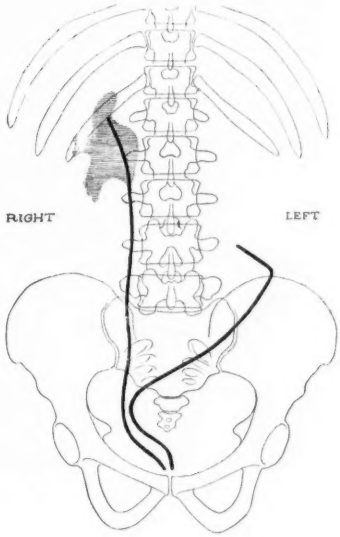

Fig. 11. Case 18. (Right pyelogram.) Hydronephrosis.

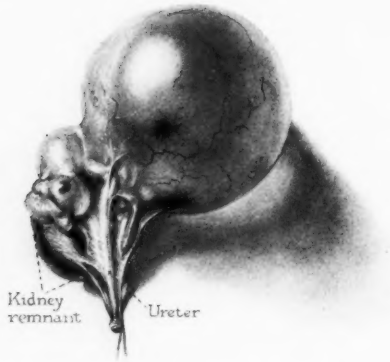

Fig. 12. Case 19. (Infant, aged 3 months.) The presence of one large cyst in the upper pole of the kidney and several small cysts with a small remnant of kidney tissue.

internal treatment, while in another group there is no response to any sort of internal treatment. The one factor that has contributed more than any other to the understanding of these cases is the pyelo-ureterogram, through which is shown the important rôle played by stasis and faulty drainage, and the frequency with which hydronephrosis and hydroureter occur.

In this group of cases the colon bacillus is the common invading organism, but by no means the only one. Other organisms found are as follows: staphylococcus albus, staphylococcus, eberthella group, streptococcus, streptococcus hæmolyticus, salmonella group, pyocyaneus, and pneumonococcus.

Discussion is still rife as to the relationship between pyelitis and the infections of the nose and throat which are often classified under "grippe." The "grippe" infections are generally due to organisms of the coccal group, whereas in pyelitis the colon bacilli are found. Some claim that the colon bacillus overgrows the other organisms so that an erroneous impression is given. This phase of the subject is still open to investigation and discussion.

I will not burden you with a discussion of the various theories concerning the route or path of infection, but will simply say that they are three in number and are designated as urogenous, lymphogenous, or hæmatogenous.

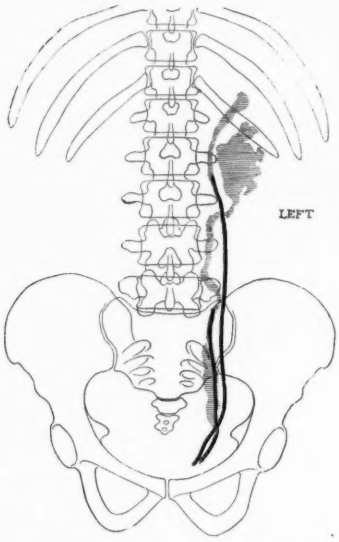

Fig. 13. Case 20. The presence of a double kidney with double ureter terminating in the bladder. The upper half shows a rudimentary pelvis and the lower half a large hydronephrosis.

As previously mentioned, there seem to be two groups of cases: In the first group the disease apparently runs a self-limited course, the patients get well with or without medical treatment, and no difficult problem is presented. In the second group of cases, there is a history of few or many recurring attacks of acute pyelitis with its symptoms of chills, fever, sweats, and often great prostration. Gastro-intestinal symptoms are occasionally present. When the acute attack subsides the urine seldom clears up entirely, and even when it clears as occasionally happens, colon bacilli are nevertheless found on culture. In the group of relapsing cases, and even in some cases in which there has been only one attack of pyelitis, the examination of urine often shows the presence of pus or colon bacilli, or both. When medical treatment fails in this group of cases, the patient should be subjected to a complete urological study. A more or less arbitrary period of time should be fixed beyond which it should be considered unwise to carry internal treatment without a definite knowledge of what the underlying pathology might be. I believe that in the ordinary case of acute

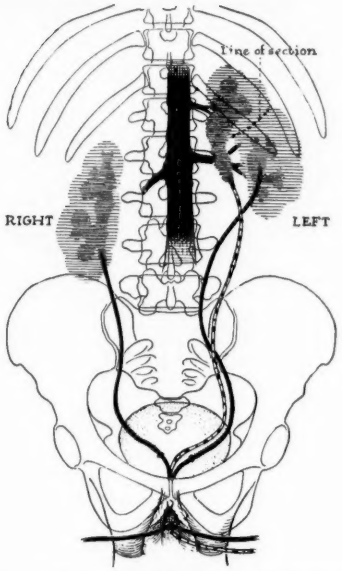

Fig. 14. Case 22. The location of the opening of the accessory ureter below the external urethral orifice. This ureter drained the upper half of the kidney. The right kidney shows moderate hydronephrosis.

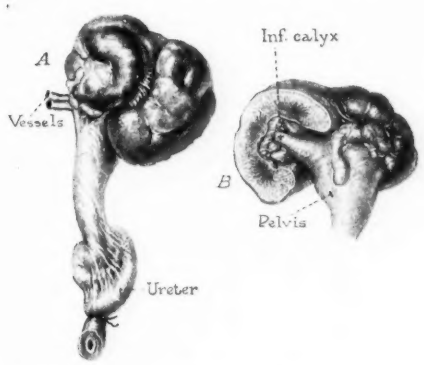

Fig. 15. Case 22. The resected upper half of the double kidney. *A*, View showing the vessels at the dilated ureter and the adhesions of the ureter producing obstruction. *B*, Showing the small margin of kidney tissue and dilated pelvis.

pyelitis and in some of the cases in which pyuria persists, the patient should not be rushed into a cystoscopic examination; but I do believe that if the case has been carefully managed for a period of, say, 6 months,[1] and if the pyuria does not clear up and the attacks of renal infection continue to recur, then it would seem that the indications are definite to subject the little patient to a careful and complete urological survey.

In the second group of cases, it should be remembered, that the organs have become extensively involved, which of course is responsible for the chronicity of the disease. The lesions are obstructing in character, thus causing a dilatation of the ureter and kidney pelvis with stasis as well as other local conditions favorable for the development of attacks of acute pyelitis.

In the acute cases the treatment offers no serious problem—rest in bed, the administration of large quantities of fluid, and careful attention to the gastro-intestinal tract generally suffice. In many cases a history of recurring attacks of head colds is given, and in these patients particular attention must be paid to the nose and throat.

In the relapsing cases the treatment depends, of course, on the underlying pathological condition. Before the routine use of pyelograms, some patients were subjected to ureteral catheter drainage, but in most of them pelvic lavage with silver nitrate or one of the newer silver salts was carried out, and the effect was quite striking in that the urine cleared up and the cultures became sterile. In some patients, however, bacteriological cures were exceedingly difficult to obtain, due to the fact that an organic disease generally leading to stasis was present; stricture of the ureter with dilatation of the ureter and kidney pelvis and hydronephrosis due to obstruction at the ureteropelvic junction call for more drastic treatment than simple pelvic lavage.

It is possible that some of the early cases treated by pelvic lavage were improved or cured, not through the lavage alone, but through the dilatation, the result of the ureteral catheterization. Since the advent of pyelography, it is difficult to ascribe all these cures to the passage of small catheters for we know that in many cases the dilatation is enormous. Moreover, we have treated a number of patients by means of pelvic lavage without either clearing up the infection or

[1] Since the advent of intravenous urography there is no objection to making intravenous pyelograms at the end of 4 or 6 weeks if the infection does not clear up.

influencing the dilatation, materially, if at all. In several instances in which the patient had definite stricture of the ureter at the ureteropelvic junction, systematic ureteral dilatation seemingly had no effect on the dilatation or infection.

It would seem that when dilatation and pelvic lavage have no effect on the patient's condition, one is justified in advising surgery. This has been my course in a certain number of cases of stricture at the ureterovesical junction. The operation consists in a suprapubic cystotomy and division of the strictured area with scissors through the open bladder, followed by dilatation of the ureteral stricture with ordinary urethral sounds. If the kidneys are to be saved I believe one is justified in advising surgery, for in my experience the patients I operated upon had been very thoroughly and conscientiously treated with dilatation without effect; in one case five ureteral catheters had been introduced but even this degree of dilatation had had no influence upon the patient's condition.

Many cases of stricture of the ureter have been reported as congenital in origin. No doubt, in a certain number of cases this is true, particularly in young children, for large hydronephroses have been found in the newborn, but whether one is justified in classifying all strictures in children as congenital, may be open to some discussion.

ILLUSTRATIVE CASES OF ACUTE AND CHRONIC INFECTIONS OF THE KIDNEY

Bilateral chronic nephritis and pyelitis

CASE 13. M. McN., female, aged 13 years, referred by Dr. George Parker, was admitted to the Presbyterian Hospital, August 6, 1929. At age of 26 months, patient had had a streptococcic sore throat followed by nephritis. Tonsillectomy performed at that time. About 6 months ago œdema of lower extremity, eyes, and lips was noticed. One month ago pus was found in the urine. For the past 2 weeks there has been some urgency, and the urine can be retained only with much discomfort. Physical examination was negative. Urinalysis showed albumin +, blood +, hyaline and granular casts +. Blood examination showed: red cells 4,000,000, leucocytes 13,800, hæmoglobin 80 per cent. The systolic blood pressure was 134, diastolic 76. Blood chemistry showed urea nitrogen 19.4, uric acid 7.3, creatinine 1.9, non-protein nitrogen 34.1. The Wassermann test was negative.

Cystoscopic examination showed a normal bladder and ureteral orifices. The ureters were catheterized without difficulty or obstruction. Examination of the urine obtained at that time showed the following:

	Leucocytes per c.mm.	Cultures	Tubercle bacillus
Bladder.....	100	Staphylococcus albus	0
Right kidney..	220	Staphylococcus albus	0
Left kidney...	350	Sterile	0

The guinea-pig test showed the urine from the bladder, and from the right and left kidneys negative for tuberculosis.

The phthalein test showed a return in the first half hour of 29 per cent, in the second half hour of 9 per cent, and in the third half hour of 5 per cent, a total in 1½ hours of 43 per cent.

TREATMENT, CASE 13

Date	Leucocytes per c.mm.			Cultures			Treatment
	Bladder	Right	Left	Bladder	Right	Left	
8-13-29	125	150	398	Colon bacillus	Sterile	Colon bacillus	2% silver nitrate into each kidney
8-22-29	35	112	181	Colon bacillus	Sterile	Sterile	2% silver nitrate into each kidney
9-26-29	225	184	320	Sterile	Sterile	Sterile	2% silver nitrate into each kidney
11-12-29	45	90	NSF	Sterile	Sterile	Sterile	2% silver nitrate into each kidney
12-10-29	220	75	125	Sterile	Sterile	Sterile	2% silver nitrate into each kidney

Result: examination by Dr. Parker, September 19, 1930, revealed a normal blood chemistry and a normal urine except for a trace of albumin and a few hyaline and granular casts.

Pyelitis—right

CASE 14. M. O., female, aged 5 years, was admitted to the Presbyterian Hospital, on the service of Dr. C. Grulee, June 1, 1928. A left nephrectomy had been performed at the age of 5 months because of an infected hydronephrosis. Following an attack of chicken pox, 6 months ago, the child continued to run a temperature, and, on examination, pus was found in the urine, for which she received treatment in the hospital. Upon admission to the hospital at this time pus was again found in the urine. Physical examination was negative. Urinalysis showed albumin 0, sugar 0, blood 0, pus cells +++. Blood examination revealed: red cells 4,330,000, leucocytes 9,700, hæmoglobin 60 per cent. The blood chemistry analysis showed urea nitrogen 15.4, uric acid 4.4, creatinine 1.5, non-protein nitrogen 36.4.

Cystoscopic examination, June 14, 1928, revealed a normal bladder. The right ureter was catheterized

without difficulty or obstruction. Examination of urine obtained showed the following:

	Leucocytes per c.mm.	Cultures
Bladder	230	Colon bacillus
Right Kidney	1040	Colon bacillus

Pyelogram of right side showed the kidney pelvis at second lumbar and within normal limits. The ureter appeared normal.

TREATMENT, CASE 14

Date	Leucocytes per c.mm.		Cultures		Treatment
	Right	Bladder	Right	Bladder	
6–14–28	1040	230	Colon bacillus	Colon bacillus	
6–20–28	240	720	Colon bacillus	Colon bacillus	3 c.cm. 1% Agno 3 into right kidney
6–27–28	360	3	Colon bacillus	Colon bacillus	3 c.cm. 1% Agno 3 into right kidney
7–26–28	50	4	Sterile	Sterile	4 c.cm. 1% Agno 3 into right kidney
8–22–28	0	0	Sterile	Sterile	8 c.cm. 1% Agno 3 into right kidney

Result: free of symptoms, 8 months later, with negative urinary examination.

Bilateral ureteral strictures, hydroureters, hydronephrosis, and pyelitis

CASE 15. P. C., female, aged 5 years, was admitted to the Children's Memorial Hospital, on the service of Dr. Aldrich, June 5, 1928. The child had been perfectly well up to 1 year ago, at which time pus was found in the urine. Internal treatment had been given. Physical examination was negative. Blood examination showed red cells 4,040,000, leucocytes 16,800, hæmoglobin 75 per cent. The systolic blood pressure was 106, diastolic 80. Blood chemistry analysis showed urea nitrogen 17, uric acid 3.0, creatinine 1.4, non-protein nitrogen 33. Urinalysis showed albumin +, sugar 0, blood 0, pus +. Roentgen-ray examination was negative for stone.

Cystoscopic examination revealed small cysts on the trigone, possibly cystitis cystica. The ureters were catheterized without difficulty or obstruction and examination of the urine obtained showed:

	Leucocytes per c.mm.	Cultures	Tubercle bacilli
Bladder	1395	Colon bacillus	0
Right kidney	195	Colon bacillus and staphylococcus	0
Left kidney	405	Colon bacillus	0

Pyelograms (Fig. 9) showed dilatation of both ureters and kidneys.

Treatment consisted in dilatation of the ureteral strictures and pelvic lavage with silver nitrate. Eight dilatations and eight pelvic lavage treatments

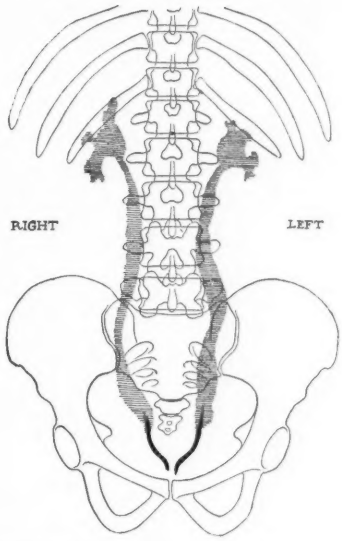

Fig. 16. Case 24. Bilateral ureteral strictures, hydroureters, and hydronephrosis.

gave no improvement as regards the dilatation of the strictures. Operation was advised. On October 25, 1928, a suprapubic cystotomy was done. Both strictures were dilated, beginning with a No. 8 French bougie. Bougies of increasingly larger sizes were used up to a No. 18 French sound which was passed without any trouble.

Result: patient made an uneventful recovery and left the hospital much improved. Subsequently she was given seven treatments of ureteral dilatation and pelvic lavage with silver nitrate.

Right hydronephrosis, stricture of right ureter, and bilateral pyelitis

CASE 16. P. E., female, aged 4 years, referred by Dr. W. W. Ross, LaPorte, Indiana, was admitted to the Presbyterian Hospital, September 15, 1925. Patient had had a light attack of measles 4 months ago. Two weeks later she began having frequency, burning on urination, and pain in the region of the right kidney. The temperature at this time was as high as 105 degrees. During the height of the fever there was little or no pus present in the urine, but directly the fever subsided examination of the urine showed many pus cells. She has had four such attacks during the past 4 months, the 2 last being more severe than the previous ones. Physical examination was negative. Urinalysis showed albumin 0, blood 0, sugar 0, pus +, occasional granular casts. Blood examination showed red cells 5,100,000, leucocytes 15,000, hæmoglogin 90 per cent. Blood chemistry analysis showed urea 35, uric acid 3.0, creatinine 1.25, non-protein 32.

Cystoscopic examination revealed a normal bladder and ureteral orifices. No urine was obtained from the right side. Examination of urine from left kidney showed 600 leucocytes per cubic millimeter; cultures were sterile. A pyelogram of the right side showed the kidney pelvis at a level with the third lumbar vertebra. The pelvis was large. The ureter was definitely dilated and tortuous from the curve to the midline of the spine. A pyelogram of the left side showed the kidney pelvis at a level with first and second lumbar vertebræ and within normal limits and a very slight dilatation of the ureter, the slightness of which is apparently of negligible importance. Treatment consisted in internal medication and pelvic lavage with silver nitrate.

Urinalysis, September 22, 1925, showed:

	Leucocytes per c.mm.	Cultures
Bladder	20	Sterile
Right kidney	30	Sterile
Left kidney	60	Sterile

Result: cured.

Bilateral hydroureter, hydronephrosis, pyonephrosis, and left ureteral stricture

CASE 17. E. D., male, aged 9 years, was admitted to the Children's Memorial Hospital, on the service of Dr. Backman, May 3, 1927. Child was apparently well up to about 1 year ago. He now complained of pain in abdomen, difficulty of urination, and tenesmus. He has been losing weight; appetite is very poor. Physical examination revealed an anæmic, poorly developed and poorly nourished child, not acutely ill. The tonsils were large, cryptic, and injected. Examination of the heart revealed faint systolic murmur at the apex. The abdomen was of the tense type with very thin wall, and prominent veins. Peristaltic waves were visible through the abdominal wall. The external genitalia were negative except for marked phimosis. Urinalysis showed albumin ++, blood 0, sugar 0, pus +, casts 0.

Blood examination revealed red cells 4,230,000, leucocytes 15,000, hæmoglobin 60 per cent. The systolic blood pressure was 114, diastolic 80. The Wassermann test of the spinal fluid was negative. A cystoscopic examination was made under ether anæsthesia, July 20, 1927. A shelf could be seen behind the interureteric ligament and a few dimplings behind and to the right of the right ureteral orifice. Large flakes of pus adhered to the bladder wall. Both ureters were catheterized and examination of the urine obtained showed:

	Leucocytes per c.mm.	Cultures	Guinea-pig inoculation for tuberculosis
Bladder	1460	Staphylococcus albus	...
Right kidney	1200	Staphylococcus albus	0
Left kidney	600	Staphylococcus albus	...

Residual urine was 125 cubic centimeters.

Pyelograms of the left side (Fig. 10) showed enormous dilatation of the ureter and kidney pelvis; of the right side, dilatation of ureter and kidney pelvis.

Treatment: The patient was carried along with catheter drainage and bladder irrigations for 5 months. On March 29, 1928, under ether anæsthesia, operation was performed through a suprapubic cystotomy. The bladder was examined. The wall was thickened. A shelf was seen across the base at the bladder neck. The right ureteral orifice was not found; two superficial diverticula were seen to the right of the usual normal location for the right ureteral orifice. The left ureteral orifice was dilated with Nos. 6, 8, and 12 (English) bougies and cut upward for ¾ inch. A wedge-shaped piece of tissue was removed from the base of the bladder neck. A No. 18 urethral sound was passed.

Result: uneventful convalescence. Patient was discharged from the hospital, June 26, 1928.

Bilateral hydronephrosis

CASE 18. D. J., a male, aged 1½ years, was admitted to the Children's Memorial Hospital, on the service of Dr. J. Brenneman, February 16, 1928. The child's abdomen had been large since birth. There were no symptoms. The child had always been well. Physical examination was negative except for the abdomen. Dr. Brenneman found that on the right side, deep-seated, and extending from about an inch below the costal border nearly to the brim of the pelvis was a hard, nodular, cordlike mass that was freely movable and did not protrude far into the abdomen. The child was admitted to the hospital a second time on June 26, 1928, at which time examination showed the mass to be larger and softer. Urinalysis disclosed albumin 0, sugar 0, blood 0, pus +. Blood chemistry analysis showed urea nitrogen 14, uric acid 2.9, creatinine 1.4, non-protein nitrogen 31. Cystoscopic examination revealed a normal bladder. The ureters were catheterized without difficulty or obstruction. The urine obtained at that time showed:

	Leucocytes per c.mm.	Cultures
Bladder	4445	Staphylococcus
Left kidney	45	Sterile
Right kidney	10	Sterile

Pyelograms revealed bilateral hydronephrosis (Fig. 11, right pyelogram).

On July 17, 1928, under ether anæsthesia, a right nephrectomy was done. There was an enormous hydronephrosis and no kidney tissue was left.

Result: uneventful recovery. Patient was discharged from the hospital, August 14, 1928.

CONGENITAL ANOMALIES

It is generally assumed that congenital anomalies of the genito-urinary tract in infants and children are rare, due to the fact that such anomalies may cause no symptoms. Although this assumption is based upon past experiences, there can be no doubt that the present statistics will of necessity have to be

revised due to the fact that interest in this subject is increasing and many more cases will doubtless be reported in the near future. The pathologists, especially those connected with children's hospitals, being more interested in the matter than some years ago, will undoubtedly report the results of their studies.

In a series of 153 consecutive necropsies on children, Bigler found an incidence of 13 per cent of congenital anomalies of the urinary tract. Bugbee and Wollstein found anomalies in 2.3 per cent in a study of 4,903 autopsy reports. Brown and Corbeille, in a study of the urinary tract of 80 fetuses and young infants, found malformations of the kidney in 20 per cent and malformations in the ureter in 11.25 per cent. In their series of 80 cases there were 3 cases of hydrocephalus and each of these showed definite kidney and ureteral deformities.

Further evidence of the frequency of the occurrence of these anomalies has been found in some of the recent publications. For instance, Lowsley and Butterfield, in a series of 100 cases of urological conditions in infancy and childhood, found 29 instances of congenital anomalies, 13 of which were of such a nature that they probably influenced an infection of these organs. Beer and Hyman, in reporting a series of 150 urological conditions in children, found one-third due to anomalies.

Mertz, in a paper based on 49 cases of chronic pyuria in infancy and childhood, found congenital changes in 20, or 40 per cent.

Except in very obvious cases, such as a very large congenital hydronephrosis found on physical examination or in cases of ectopic ureters that open into the urethra or vagina, the diagnosis is made during the course of routine urologic study. Even in cases in which both ureters open into the urethra and can be seen with the eye, it is necessary to subject the patient to a complete cystoscopic examination. The type of anomaly in which both ureters open into the urethra, without accessory ureters opening in the bladder, is rare. Heaney and I reported a case belonging to this group in which both ureters opened into the urethra.[1]

[1] J. Am. M. Ass., May 11, 1929, xcii, 1585–1587.

The mere fact that an anomaly is present should not lead one into believing that symptoms will occur on account of the anomaly itself; as a rule, symptoms are completely absent, and on account of their absence, the anomaly, I regret to state, is frequently overlooked. On the other hand, congenital anomalies not infrequently produce interference with urinary drainage so that stasis results, and sooner or later secondary infection intervenes. The infection, it should be emphasized here, is accompanied by chills and fever and pus in the urine, and medical management has no effect on the condition. It is these factors which result in bringing the patient to the urologist.

It is not my intention to discuss all the congenital anomalies which may occur but I will present brief reports of some of the cases that I have seen. In some of the cases of stricture and hydronephrosis it may be difficult to arrive at the conclusion of a congenital origin of the lesion, but in others the congenital origin is self-evident.

ILLUSTRATIVE CASES OF CONGENITAL ANOMALIES

Congenital solitary cyst of the kidney

CASE 19. J. H. C., female, aged 3 months, referred by Dr. Parmelee, was admitted to the Presbyterian Hospital, October 4, 1930. Off and on since birth the child had been troubled with vomiting and diarrhœa. She had failed to gain weight. Three weeks ago the mother noticed an enlarged abdomen. No urinary symptoms were noted. Physical examination by Dr. Parmelee was negative except for a very thin, distended abdomen. Peristaltic waves of stomach and loops of bowel were seen through the thin abdominal wall. A firm, rounded tumor mass, the size of a small orange and slightly tender to pressure, was noted in the region of the right kidney. The mass extended down nearly to the crest of the ilium. With the use of uroselectan pyelograms were made. On the left side the pyelogram was normal. No pyelogram was obtained in the right side. Blood examination revealed red blood cells, 3,620,000; leucocytes, 13,500; hæmoglobin 70 per cent. Urinalysis showed reaction, acid; albumin, 0; blood, 0; sugar, 0; few epithelial cells.

Diagnosis: Tumor of right kidney, probably malignant; and operation advised.

On October 22, 1930, under ether anæsthesia, a right nephrectomy was done. When the kidney was exposed, a large cyst, the size of a lemon, was found (Fig. 12). This cyst was firmly attached to the lower pole of the kidney and several other cysts were seen

in the kidney. Although it was possible to resect the cyst, it was decided to do a nephrectomy because of the presence of the other small cysts in the kidney.

Result: patient developed bronchopneumonia and died November 15, 1930.

Double kidney—left—with double ureter terminating in the bladder, strictures of ureters and hydronephrosis

CASE 20. A. B., female, aged 10 years, was admitted to the Children's Memorial Hospital, on the service of Drs. Kaufman and Williams, August 7, 1929. For the past 6 years she had had many attacks of pyelitis and bronchitis for which she had received treatment. Pus had been present in the urine almost constantly. There had been some frequency of urination and loss of appetite. Physical examination was negative. Urinalysis showed albumin ++, pus +++. Blood chemistry analysis showed urea nitrogen 16, uric acid 3, creatinine 1.3, non-protein nitrogen 35. Blood examination revealed red cells 4,100,000, leucocytes 12,400, hæmoglobin 85 per cent. Roentgen-ray examination was negative for stone. Cystoscopic examination revealed two left ureteral openings; the upper one œdematous, swollen, and gaping; the lower one, normal. Both were catheterized. The right ureteral orifice was normal. The urine obtained at that time showed:

	Leucocytes per c.mm.	Cultures	Tubercle bacilli
Bladder.....	40	Colon bacillus	0
Lower left.....	35	Sterile	0
Upper left.....	35	Sterile	0
Right.....	10	Colon bacillus	...

A left pyelogram (Fig. 13) showed double kidney with double ureters terminating in the bladder, strictures of double ureters and hydronephrosis.

On August 22, 1929, under ether anæsthesia, a suprapubic cystotomy was made, the stricture of the upper left ureter was cut; and sounds up to No. 17 French were passed through the upper and lower ureteral orifices. Recovery uneventful.

Accessory ureter opening into the urethra

CASE 21. G. B., female, aged 6 years, was admitted to the Children's Memorial Hospital, September 6, 1928. Two years ago the patient had a sore throat with abdominal pain. Pus was found in the urine. This condition improved with medical treatment. Six months ago the child had an attack of pneumonia and again a large amount of pus was found in the urine. The condition again improved with internal treatment and the patient was well until 1 week ago when she developed a severe sore throat and pus was again found in the urine. In this present attack there were noted enlarged glands of the neck, the temperature was 103 degrees, and there was frequency of urination. Physical examination disclosed a well developed and nourished child with enlarged cervical glands and a severe nasal discharge. There was slight tenderness over the left lumbar region. Urinalysis showed albumin ++, sugar 0, blood ++, much pus, many red blood cells. Blood examination showed red blood cells 4,330,000, leucocytes 16,850, hæmoglobin 70 per cent. Blood chemistry analysis showed urea nitrogen 4, creatinine 1.6, non-protein nitrogen 42. Roentgen-ray examination was negative for stone. Cystoscopic examination showed the bladder and ureteral orifices to be normal. The ureters were catheterized. Examination of the urethra showed the opening of an accessory ureter just anterior to the internal sphincter. Pus was seen coming from this ureter. The catheter passed into this ureter for only a short distance. Culture showed streptococcus viridans. Pyelograms disclosed bilateral hydronephrosis. Operation advised and refused.

Accessory ureter opening at the external urethral orifice

CASE 22. P. D., female, aged 9 years, was admitted to the Children's Memorial Hospital, September 11, 1930. Urinary dribbling had been present since birth. As a baby she never had a dry diaper. It was thought the child would do better when older and trained but these expectations were never realized; the bloomers were wet shortly after changing. She urinated frequently and the urine could not be held for long periods of time; between urinations, there was constant dribbling. Condition had become more marked during the past 2 years. Physical examination was negative except that over the middle of the sacrum in midline dorsally there was a defect in the bone that admitted two fingers. External genitalia were negative except that just below the external urethral orifice was seen a small opening that discharged urine. A ureteral catheter was inserted into this opening and a prompt flow of urine was obtained. Cystoscopic examination was carried out while the catheter was in place. A normal bladder and two normally located ureteral orifices were found. The ureters were catheterized without difficulty or obstruction. Pyelograms were made (Fig. 14).

Examination of urine obtained at this time showed the following:

	Leucocytes per c.mm.	Cultures
Bladder.....	195	Bacillus pyocaneus
Accessory ureter...	157	...
Left ureter.....	257	...
Right ureter.....	325	...

Roentgen-ray examination was negative for stone. Spina bifida occulta was present.

Blood examination showed red blood cells 4,060,000, leucocytes 10,950, hæmoglobin 80 per cent. Urinalysis showed albumin ++, blood 0, sugar 0. Sediment showed pus and red blood cells. On October 2, 1930, under ether anæsthesia, a heminephrectomy was done with resection of the accessory ureter, as far down as was convenient (Fig. 15). The normal ureter, as well as the accessory ureter, was dilated and tortuous. Histological report:

kidney resected showed the presence of chronic pyelitis and hydronephrotic atrophy.

Result: recovery uneventful.

SPINA BIFIDA

In spina bifida cases certain urinary symptoms occur that bring these patients to consult the urologist at once, and at other times the urinary symptoms are so pronounced that the advice of the urologist is sought. Although spina bifida is rare, nevertheless these cases form an exceedingly interesting group from the standpoint of differential diagnosis. Because of the associated incontinence, many cases are regarded as, and treated for, enuresis; of course, with complete failure. All cases of suspected enuresis, therefore, should be subjected to a careful and complete urological study as well as to a neurological examination to rule out organic disease as a factor in the production of the so-called enuresis. This applies not only to spina bifida cases, but to cases of renal tuberculosis with bladder symptoms and stone in the bladder.

The management of spina bifida cases is, of course, exceedingly difficult; at present the tendency seems to be to subject these patients to a laminectomy.

Those interested in this problem are referred to the recent article on this subject by Mertz and Smith who report 13 cases and give a careful review of the literature on the subject.

ILLUSTRATIVE CASE OF SPINA BIFIDA

Spina bifida, bilateral hydroureter, hydronephrosis, and pyelitis—left

CASE 23. G. C., female, aged 2 years, was admitted to the Presbyterian Hospital, April 13, 1928. She had had a lump on the back since birth. The lump seemed to grow at the same rate as she did generally. She had suffered from involuntary urination since birth until 4 weeks ago, when complete retention developed. She was catheterized daily for 4 days. Involuntary urination again occurred until 5 days ago, when complete retention developed. For the past 7 weeks the urine had been cloudy. She had had chills and fever with temperature varying from 99 to 105 degrees. Physical examination was negative except for a rather prominent abdomen, with large abdominal veins. The bladder could be felt 2 inches above the pubis as a firm, thick organ. Over the lumbar vertebræ was a large, soft, fluctuant area about 4 inches in diameter, covered with skin, which protruded about 1½ inches. Neurological examination was negative. Blood examination showed red cells 4,120,000, leucocytes 16,200, hæmoglobin 75 per cent. Cystoscopic examination revealed a normal bladder. The ureters were catheterized without difficulty or obstruction. Urine obtained at that time showed:

	Leucocytes per c.mm.	Cultures
Bladder	150	Colon bacillus
Right kidney	50	Colon bacillus
Left kidney	0	Sterile

Pyelograms were made and showed slight dilatation of kidney pelves and calyces; marked dilatation of ureters.

Result: patient left the hospital without permission.

OBSTRUCTION TO THE OUTFLOW OF URINE

Lesions of the urinary tract which cause obstruction to the outflow of urine may be located anywhere along the urinary tract from the urethral orifice to the vesical neck, and they produce what is called mechanical obstruction. There is another type of obstruction which is due to disease of the central nervous system and, hence, is neurologic in origin. Among the former type may be mentioned a very tight prepuce as well as a pinpoint meatus—lesions which are obvious and offer no diagnostic problem. Lesions of the urethra, such as tumors (very rare) and urethral calculi may produce obstruction to the outflow of urine.

Obstruction at the vesical neck, so-called fibrosis of the vesical orifice, was formerly looked upon as a very rare condition occurring only in the adult. When the urinary problems of infancy and childhood became more intensely studied, however, obstruction at the vesical neck became more and more frequently recognized; so that today, judging from recent writings, these lesions are not really rare. All the cases I have seen have been in boys, and while it seems to be the general belief that the lesion is peculiar to the male sex, Beer and Hyman state that they have seen a similar picture in girls.

The symptoms very often are highly suggestive of a lesion at the internal urethral orifice. The parents or nursemaid state that the patient is obliged to strain a good deal; sometimes before the act of urination is started. In one of my cases a little boy had

great difficulty in starting the stream, and after the stream was started great straining was necessary to complete the act. He resembled, from this viewpoint, the old prostatic.

Associated with the great straining is the ability to make only a very small stream. Here, as in prostatic obstruction, the amount of residual urine increases and there is a gradually increasing frequency of urination both by day and night. Sooner or later infection sets in and the urine becomes turbid. Systemic manifestations occur in the form of chills and fever, followed by sweats. Unfortunately, the true condition is not recognized, and the patient continues to be treated for relapsing pyelitis. Unless the obstruction is relieved, the infection increases; and eventually renal function is impaired, weight and appetite are diminished, and severe anæmia develops.

In one group of cases the first symptom noted was the presence of a suprapubic tumor which was generally discovered by the mother or the nursemaid. Dribbling may be so marked that the patients are continually wet, that is, they soil their clothing by day and wet the bed at night. They are often treated for enuresis; of course, without relief since the true condition is not recognized.

The diagnosis, as a rule, presents no difficulties. Difficulty on urination with dribbling and the presence of a suprapubic tumor are almost pathognomonic, and the passage of a small, soft catheter demonstrates the presence of residual urine. When the catheter is passed, advantage should be taken of it to make a cystogram at the same time. The cystogram will show the presence of a very large bladder, frequently with regurgitation of the bromide solution up the ureters, thus demonstrating the presence of hydro-ureters and hydronephroses. In the early cases the dilatation is only moderate, while in some of the late cases it is extremely marked. It is in this group of cases that uroselectan will be of great value in demonstrating the associated hydro-ureters and hydronephroses, since the phenomenon of regurgitation does not always occur when the cystograms are made.

Although fibrosis is the common cause of obstruction at the vesical orifice, other pathological conditions occasionally are the cause. In a case previously reported the obstruction was due to a prolapse of the ureter which covered the internal urethral orifice, thus causing obstruction, residual urine, and enormous dilatation of the higher urinary tract.[1]

The treatment must be directed toward relieving the obstruction. Preliminary bladder drainage and improvement of the renal function is necessary in some of the advanced cases. All the cases of this type of obstruction reported here have been treated by means of a suprapubic cystotomy with excision of a wedge-shaped piece from the fibrous neck, followed by a digital dilatation of the urethra. If valves are present in the posterior urethra, they may be destroyed at the same time.

HYPERTROPHY OF THE VERUMONTANUM

Hypertrophy of the verumontanum may produce a very marked obstruction to the outflow of urine, and cases have been reported in which the obstruction led to complete renal atrophy and death. Bugbee and Wollstein have studied cases of this type of obstruction, and Robinson has published an excellent article on hypertrophy of the verumontanum as a factor in urinary obstruction, with a detailed report of 1 case.

ILLUSTRATIVE CASE OF OBSTRUCTION

Contracture of the vesical neck with bilateral ureteral strictures, hydro-ureters and hydronephrosis

CASE 24. P. S., male, aged 5 years, was admitted to the Children's Memorial Hospital, on the service of Dr. Aldrich, September 13, 1927. The child was well until 10 months ago. Following an acute cold, urination was painful and necessitated great straining. Because of pain, the child held his urine as long as he could and voided only two or three times a day. He strained so much that the bowels sometimes moved at the same time; and these stools at times showed blood. He has had "sore eyes" since he was 10 days old. He has a slight conjunctivitis with triangular opacity in left lower quadrant of the cornea. The heart, lungs, and abdomen were negative, as were the external genitalia, negative. Roentgen-ray examination was negative. Urinalysis showed cloudy urine, albumin +++, sugar 0, pus ++++, few red blood cells. Cultures showed staphylococci. Blood

[1] Am. J. Dis. Child., 1927, xxxiii, 952–977.

chemistry analysis showed urea nitrogen 17, uric acid 2.5, creatinine 1.5, non-protein 35. Residual urine was 345 cubic centimeters. At cystoscopic examination the cystoscope entered with a feeling of tightness. The internal urethral orifice was white and a small elevation was seen at the base of the bladder. The catheters met an obstruction on both sides and no urine was obtained from either kidney. Examination of the bladder specimen at this time showed: 2,500 leucocytes per cubic millimeter. Culture showed staphylococci.

Bilateral pyelograms (Fig. 16) were made and showed enormous dilatation of the ureters from the ureterovesical junction to the kidney pelvis, and bilateral hydronephrosis. Operation was done November 1, 1927, and consisted in a suprapubic cystotomy for drainage with daily irrigations. A second operation was done, July 17, 1928, when a wedge-shaped piece of tissue was removed from the internal urethral orifice and the posterior urethra was dilated with the fingers. The ureters were dilated with Van Buren sounds up to and including No. 16 French, and No. 12 soft rubber urethral catheters were inserted into the ureters for drainage. Subsequent pyelograms showed a normal kidney pelvis and ureters on the left side and a very slight remaining dilatation on the opposite side.

Result: patient made an uneventful recovery and left the hospital much improved.

DIVERTICULUM OF THE BLADDER

Diverticulum of the bladder in children is generally associated with obstruction at the neck of the bladder. Although the condition is rare in children, the possibility of its presence must always be thought of in every case in which a diagnosis of fibrosis of the vesical neck has been made. Unless diverticula are recognized and removed, particularly if they are large, the result may be failure to relieve the patient of his symptoms to remove which a surgical operation has been done just as failure to remove a diverticulum in the adult is the cause, in many instances, of prostatectomy failing to give relief. Diverticula may be very easily demonstrated by means of the cystogram. As a rule, the opening of a diverticulum can be seen on examination with the cystoscope, yet it is well known, especially if the patient is examined during a sharp attack of cystitis, that the diverticulum may be overlooked.

As a rule, the orifice of the diverticulum is small and presents no relationship to the size of the sac. The opening appears as a round hole, its edges are sharply defined, and the mucous membrane may show some puckering. Diverticula vary in size from a small sac the size of a hazelnut to an extremely large sac that may be almost as large as the bladder itself.

Diverticula occur with predilection in the region of the ureteral orifices and the ureteral opening may be found in the sac. Great care must be exercised, therefore, in their removal lest the ureter be injured during the dissection.

Bladder diverticulum and contracture of bladder neck

CASE 25. R. C., male, aged 2½ years, referred by Dr. Krost, was admitted to the Presbyterian Hospital, August 19, 1923. Dribbling of urine has been noted since birth. For the past 2 months the child has had chills, fever, vomiting, and bladder distention. Physical examination by Dr. Krost was negative except for distention of the bladder. Roentgen-ray examination was negative. Cystoscopic examination revealed marked trabeculation of the bladder and an opening of a diverticulum in the region of the right ureteral orifice. A cystogram showed a diverticulum on the right side of the bladder. Operation under ether anæsthesia was done September 18, 1923, and consisted in resection of the diverticulum. The internal urethral orifice was hard, firm, and contracted. Two incisions were made into the internal urethral orifice, which resulted in relieving the contraction. Further dilatation of the internal urethral orifice was done with the finger.

Result: patient left the hospital, October 17, 1923, completely relieved.

CONGENITAL VALVES OF THE POSTERIOR URETHRA

Congenital valves of the posterior urethra are relatively rarely found in children. If present they are seldom recognized until great damage has been done to the upper urinary tract because of mechanical obstruction. It is therefore exceedingly important that such a possibility be kept in mind in making a diagnosis in all cases of chronic urinary obstruction. Then, if proper diagnostic procedures are instituted, the condition should be recognized early instead of late, proper treatment can be instituted, and much renal damage thus prevented.

The seeming relatively rare occurrence of congenital valves of the posterior urethra is probably due to the fact that few clinical cases have been reported, and when these cases come to autopsy great renal destruction is found.

Congenital valves of the posterior urethra have been recognized for many years. Among

the earliest cases in the literature are the following:

Budd, in 1840, reported a case in a sailor, aged sixteen, who died several days after admission to the hospital in a state of coma. Godart, in 1854, compared the valves in his case to a pigeon's nest or the sigmoid valves. Picard, in 1855, described a case of true valves complicated with convulsions. Autopsies were performed in all of these cases; hence, the diagnoses were not mere speculation as they are in many instances.

In 1870, Tolmatschew wrote the first discussion on congenital valves of the posterior urethra as a definite clinical entity and brought the literature up to date. He included the cases of Budd, Bednar, Godart, and Guyon.

Young, Frontz, and Baldwin, in 1919, reported 23 cases which were found in the literature and added reports of 12 cases of their own.

In 1924, Hinman and Kutzman added 6 personal cases together with 15 cases from the literature, making a total of 56. A thorough search of the literature since Hinman's summary in 1925 revealed 8 additional cases. Recently Randall reported 2 cases which made a total of 66 cases. In 1929, Pierson and I had the good fortune to report 3 new cases which brought the total up to 69 cases. Two of these 3 cases were proved by autopsy. One case was operated upon and complete relief was obtained. Since our paper was published, Randall has reported a third case, making a total of 70 cases reported to date.

TYPES OF CONGENITAL VALVES OF POSTERIOR URETHRA

In reviewing the literature, Tolmatschew found references to several classifications, for instance Jarjavay describes circular and semilunar valves, and Bouillard mentions the possibility of twofold and threefold valves. Tolmatschew stated that the known valves have been divided into four classes, namely: (1) those posterior to the fossa navicularis; (2) those posterior to the bulbous urethra; (3) those anterior to the verumontanum; and (4) at the anterior margin of the field in front of (3).

Modern writers classify their cases according to the system of Young, Frontz, and Baldwin, which consists of three types: (1) one of two semilunar folds running anteriorly from the verumontanum toward the penile urethra; (2) semilunar folds running posteriorly from the upper edge of the verumontanum (they describe only one case of this type, in which a valve consisted of a fold); (3) the iris valve, bearing no relation to the verumontanum and attached to the entire circumference of the urethra, with a small opening near the center.

The treatment of congenital valves may be surgical or non-surgical. A suprapubic cystotomy may be made to destroy the valves. Frontz has advised the non-surgical treatment by means of an especially small constructed Young punch.

ILLUSTRATIVE CASE OF CONGENITAL VALVES

Congenital valves of the posterior urethra

CASE 26. C. E., male, aged 5 years, referred by Dr. William Hibbs, was admitted to the Presbyterian Hospital, November 12, 1928. Since birth patient had had difficulty in passing urine, the stream being small, and the act was associated with urgency and frequency. Frequency was more pronounced during the forenoon, the intervals ranging from 10 to 20 minutes. During the remainder of the day the child urinated from three to four times. Physical examination was negative except for the presence of a suprapubic tumor about the size of a large grapefruit. Examination of urine disclosed 50 pus cells per cubic millimeter. Blood chemistry analysis showed urea nitrogen 17.8, uric acid 2.7, creatinine 1.1, nonprotein nitrogen 41.7. The Wassermann test gave a negative reaction. A small cystoscope entered the bladder without difficulty or obstruction. Examination gave completely negative results. No evidence of disease around the internal urethral orifice, but it was impossible to pass a No. 16 curved sound through the prostatic urethra. Roentgen-ray examination of the spine showed no evidence of spina bifida occulta. A cystogram revealed a normal bladder, relatively large for the size and age of the patient. A urethrogram showed dilatation beyond the junction of the prostatic and membranous urethra. In front of this apparent obstruction the urethra measured 5 millimeters and behind it, 8 millimeters. A pre-operative diagnosis of congenital valves of the posterior urethra was made. Operation was done under ethylene and ether anæsthesia on November 21, 1929. Through a suprapubic cystotomy the valves were destroyed.

Result: recovery was uneventful and the patient left the hospital on December 23, 1928.

LESIONS OF THE CENTRAL NERVOUS SYSTEM

In the adult, certain lesions of the central nervous system produce both urinary and sexual symptoms; in fact urinary symptoms are present in almost all adults so afflicted. Tabes dorsalis is the most frequent lesion found but it is by no means the only lesion of the central nervous system. Much interest is again manifested in this subject of so-called spinal cord bladder. Although this condition has seldom been reported in children, doubtless due to the fact that spinal cord bladder is not a common disease of childhood, nevertheless its possibility should not be overlooked, especially when the urinary symptoms are prominent, for the underlying cause may be some disease process of the central nervous system. It should be the duty of the urologist to bear this fact in mind, when he makes his examination. It is our practice always to have a complete and careful neurological examination in all doubtful cases in order to exclude a lesion of the central nervous system.

Spinal cord bladder due to poliomyelitis

CASE 27. A. Z., female, aged 5½ years, was admitted to the Children's Memorial Hospital, on the service of Dr. Berkheiser, May 24, 1927. Patient had had infantile paralysis at the age of 3 years. Both feet had been operated upon for talipes equinovarus 1 year ago. Patient had suffered from incontinence of urine practically all her life and had never developed control of the bladder. Physical examination revealed a poorly nourished child who walked unsteadily with a tendency to the talipes position of the feet. In the lower abdomen in the midline, was a large swelling dull to percussion. Knee jerks were absent. Examination of the urine showed albumin ++, sugar 0, pus +++, casts 0. Blood chemistry analysis showed urea nitrogen 18, uric acid 4.4, creatinine 1.6, non-protein nitrogen, 44. The Wassermann test gave a negative reaction. A cystogram was negative. Cystoscopic examination revealed hypertrophy of the interureteric ligament and some trabeculation. To the right of the right ureteral orifice there was seen a small superficial diverticulum. Examination of urine obtained at that time showed:

	Leucocytes per c.mm.	Cultures
Bladder.....	164	Colon bacillus
Right kidney.....	610	Staphylococcus albus

A pyelogram of right side showed a dilated pelvis.

Neurological examination was made by Dr. Hamill. He thought the condition was due to an old poliomyelitis. The spinal fluid Wassermann test gave a negative reaction.

Treatment consisted in the use of an indwelling catheter.

Result: patient left the hospital unimproved.

Malignant tumor of spinal cord with complete retention of urine

CASE 28. E. J., male, aged 8 years, was admitted to the Children's Memorial Hospital, on the service of Dr. A. H. Montgomery, July 2, 1930. Three weeks ago the child fell down stairs (two floors) and injured his back. He got up and walked upstairs and for 3 days he had difficulty in getting about. Since then he has been confined to bed and unable to walk. Physical examination revealed an acutely ill child unable to move the lower extremities. The bladder was distended above the umbilicus. The scrotum was œdematous. Pressure over the lower thoracic region caused pain. An ulcer was noted at the external urethral orifice. There was complete loss of sensation below the costal margin. Tentative diagnosis of traumatic spine with spinal cord bladder was made. Urinalysis showed albumin +++, sugar 0, pus +, casts, many. Because of the distention and inability to void, indwelling urethral catheter drainage was advised.

Roentgen-ray examination (3 cubic centimeters of lipiodol was injected into the lumbar spine) showed a blocking of the fluid at the level of the third lumbar. Subsequent study by Drs. Hamill, Brennemann, and Loyal Davis resulted in a diagnosis of spinal cord tumor, which was verified by laminectomy.

On August 8, 1928, under ether anæsthesia, operation was done by Dr. Loyal Davis, who removed the spinal cord tumor. Histological examination showed round cell sarcoma.

Result: child continued to fail and died, November 27, 1928. Autopsy was not obtained.

Glioma of optic chiasm

CASE 29. E. M., female, aged 11 years, was admitted to the Presbyterian Hospital, on the service of Dr. C. Grulee, June 14, 1927. Patient had had enuresis since birth. Two years ago she was hit in the head by a bus. Roentgen-ray examination at that time was negative for fracture. Since the accident she has had headaches associated with pain in the eyes and vomiting which comes on only in the morning after eating breakfast. She has worn glasses for 2 years but there has been no disturbance of vision.

Physical examination was negative except for the fundus findings (Dr. Allen). The left eye showed a pseudo-papillitis; there was right incomplete hemianopsia; in left the entire upper quadrant was involved. The Wassermann test was negative.

Roentgen-ray examination of the head showed no bone change. The sella was within normal limits. Treatment consisted in the administration of salvarsan and two courses of mercury rubs followed by potassium iodide.

Patient re-entered the hospital, November 16, 1927. The complaint at this time was continued enuresis although the other symptoms had disappeared. Roentgen-ray examination of the head showed no change.

Urinalysis showed albumin o, sugar o, casts o, blood o, pus +.

Examination (H. L. K.) showed no abnormality of the external urethral orifice and no leakage of urine. Cystoscopic examination revealed a generalized trabeculation; ureteral orifices, normal. Both ureters were catheterized and the urine obtained showed the following:

	Leucocytes per c.mm.	Cultures	Tubercle bacillus
Bladder	o	Sterile	o
Right kidney	400	Sterile	...
Left kidney	120	Sterile	...

The pyelograms were normal. Wassermann tests of spinal fluid gave negative reaction; Nonne +; cells o.

Neurologic examination by Dr. P. Bassoe was negative. Treatment with mercury and potassium iodide was continued.

On March 17, 1928, the patient was admitted to the hospital for the third time. She complained of vomiting and severe headaches. Pain was most marked at the top of the head. She has wet the bed every night. Examination of the eyes by Dr. Allen showed the same findings as before. Roentgen-ray examination of the head revealed a definite increase in the size of the sella. Neurologic examination by Dr. P. Bassoe was negative except for a positive Babinski on the right side and a tendency to positive Oppenheim on both sides. Patient was transferred to Billings Memorial Hospital.

Operation was performed by Dr. P. Bailey, on January 11, 1929. A frontal exploratory operation revealed a glioma of optic chiasm.

SUMMARY

1. Lesions of the urinary tract in infancy and childhood occur with greater frequency than is generally supposed.

2. The types of lesions occurring in infancy and childhood closely parallel the types found in the adult, with the exception of benign hypertrophy of the prostate and malignant disease of the prostate and bladder.

3. In certain instances, examination has revealed the presence of serious destructive lesions of the kidney, lesions that might have been cured had an early diagnosis been made and treatment instituted.

4. The problems of diagnosis and treatment differ in no way from the same problems in the adult.

5. Close co-operation between the general practitioner, the pediatrician, and the urologist is desired so that these patients may be examined in the early stages of their disorder and thus reap the benefit of proper treatment, thereby preventing destruction of vital organs.

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ARTERIAL ENCEPHALOGRAPHY AND ITS VALUE IN THE DIAGNOSIS OF BRAIN TUMORS

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THE first study of arterial encephalography dates back to 1927. In that year, Moniz read a paper on the subject before the Society for Neurology and Academy of Medicine in Paris (1).

Since then we have been quite uniformly successful in localizing brain tumors by the method, which consists, briefly, in injecting into the internal carotids an opaque liquid which renders impervious to the X-ray the whole system of brain arteries. The alterations in the arterial system produced by the tumors are a means of locating the latter. An encephalographic study is easily made and the method may be used in any patient suspected of having a brain tumor. As to contra-indication, it should not be used in the presence of sclerosis of the brain arteries and it should not be repeated in the same case.

In addition to the instruments commonly used in a minor surgical operation, we need only two special forceps—a 10 cubic centimeter syringe and a platinum needle. The forceps, which are a kind of ring pincers of the Antonio Martins type (Fig. 1) slightly modified by one of us, are used for the temporary obliteration of the arteries. The platinum needle is 8 centimeters by 1 millimeter, and is made in the form of a bayonet.

The opaque liquid used is a chemically pure, recently prepared, watery (22 to 25 per cent) solution of iodide of sodium. As this solution is quickly diluted by the blood and thus ceases to possess the indispensable quality of opacity under the X-rays, it is necessary to photograph the head immediately after the injection and to use a sufficiently quick apparatus.

PREPARATORY TREATMENT OF PATIENT

It is advisable to give the patient 30 centigrams of luminal, both the night before and early on the day of examination. We have thus frequently avoided an accident which although not at all serious, may, at times, be troublesome because of its severity. We refer to epileptic attacks which may follow the injection. Such attacks in our experience have usually been homolateral and have been of the Jackson type.

LAYING OPEN THE CAROTID

As it is impossible to make the injection direct, it is necessary first to expose the carotids. At first we attempted to make the injection direct into the internal carotid, but at times this was found difficult, especially when the bifurcation of the common carotid was located farther up than usual. To avoid this difficulty we made the injection into the common carotid, temporarily obliterating the external carotid. In our opinion we must be eclectic; we shall follow the first practice always when practicable, which would be true in most cases, and shall reserve the second procedure for the cases in which the bifurcation of the carotid is far above the normal position. The second procedure is a very much easier one. However, in some cases it means that the incision must be made low and at times lengthened. For these reasons it is not recommended for all cases especially from an æsthetic point of view, which we must always take into account, since the procedure is but a means of diagnosis.

We always use local anæsthesia, but this does not mean that general anæsthesia should not be used in patients with precarious mental conditions. The operation can be carried out very well under a simple superficial anæsthesia, for it has been established, and the premises can be easily verified, that the deeper parts of the neck are practically insensible.

The patient is placed in the classic position required for ligature of the carotid. We then proceed to make the skin incision, which will lead directly to the bifurcation of the carotid and does not leave too conspicuous a scar.

The incision begins at the external border of the sternocleidomastoid muscle on a level with the mandibular angle and follows the course of the muscle down to the fold that separates the submaxillary region from the respective part of the neck. The incision is slightly concave toward the upper end and is 2 to 3 inches in length, depending on the development of the adipose tissue in the region. The cellular membrane of the muscle is opened and drawn backward, the inner part being cut through longitudinally. We try to locate the artery by its pulsations. There are three possible ways of isolating the artery: through the common carotid, through its bifurcation or, finally, through a spot above the bifurcation. In the first instance, which by the way is very rare, we follow the upward course of the artery and attempt to isolate the internal carotid. If this is very difficult, we isolate the external carotid so that we may obliterate it at the proper moment, and we make the injection into the common carotid, as already explained. In the other instances we isolate the internal carotid so that we may make the injection into it. We cannot identify the internal carotid solely by its position.

While as a rule the internal carotid lies clearly behind the external carotid, although somewhat deep, it may lie entirely under the external carotid. In 2 cases we found it external to the latter, and as we did not expect such an anomaly, in the first of the cases, we made the injection into the external carotid. It is evident, therefore, that the identification of the internal carotid is a difficult thing unless it can be proved that the artery has no ramifications.

If the internal carotid is easily accessible after a small segment in the first portion is isolated, the special forceps is placed at once above its origin to bring about temporary hæmostasis without compressing the artery. If we decide to inject into the common carotid, we affect hæmostasis by placing these forceps on the artery, a little below the bifurcation, and another one on the external carotid just above the said bifurcation.

TECHNIQUE OF THE INJECTION

The patient is placed in the required position under an X-ray bulb, that is, he lies on the side opposite that to be injected, with the head supported in such a way that the frame of the apparatus on which he lies remains in a horizontal position. The apparatus will be horizontal if the line of the patient's eyes is vertical. The head is held fixed in position and movement is prevented by means of a bandage. As soon as the attendant gives the signal that the apparatus is ready to use the artery is punctured by means of the needle. This procedure does not cause the patient any pain. It has been our custom, when making the puncture in the common carotid, to introduce the needle far enough to enter the internal carotid. In this way the injection is made just as though it had been started directly in the latter. Thus we avoid the reflex already mentioned—reflex the result of irritation of the reflexogenic cardio-respiratory zone of the carotid sinus. Once the artery is entered, which we know has been done when blood enters the needle, we press the hæmostatic forceps (one or two depending on whether the internal or the common carotid has been entered), and proceed with the injection. The quantity injected perhaps does not affect the result materially. We have obtained excellent radiograms with 4 or 5 cubic centimeters. At present we prefer to inject 6 or 7 cubic centimeters—a little less in the case of women—and we use 2 to 3 cubic centimeters for children. It is essential that the injection be made very quickly and that the radiogram be made at the very moment at which the quantity injected seems to be sufficient. To arrive at this result it cannot be the surgeon but an assistant who gives the photographer the necessary signal at the right moment. Once the film is developed and found satisfactory, the operative incision is dealt with in the usual manner. If the photograph does not reveal the arteries sufficiently, the injection is repeated.

We have made approximately 200 encephalograms in 100 patients with this method, and

we may say that except in the presence of arteriosclerosis and in instances in which we used an iodide solution not sufficiently pure, we have experienced no difficulties. We have thus succeeded in localizing brain tumors either by rendering visible the accessory circulation of the tumors or the dislocation of the arteries. We present brief histories of a few of our cases.

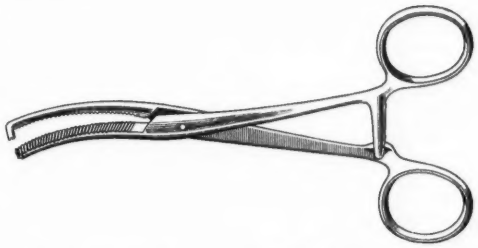


Fig. 1. Martins forceps modified by Amandio Pinto.

CASE 1. Large meningoblastoma at the base of the left temporal lobe. Maria, 36 years of age, felt quite well until 1927. In January of that year she became ill, having fever, delirium, headache, vomiting, and extreme drowsiness. In March she was obliged to stay in bed and had the same symptoms. In August she had another attack of headache, vomiting, and diplopia.

As time went on the patient felt better until January, 1928. Then she noticed rather pronounced involuntary movements in the right arm and later in the right leg. These movements did not diminish. She came to us for treatment in October, 1928, because she was losing her sight.

Examination showed facial asymmetry. Patient had a Parkinsonian facies which used to disappear on movement. The members of the right side were affected by pronounced oscillatory trembling which became stronger when moved voluntarily.

The examination of the olfactory nerve showed complete anosmia on the left side; difficulty of identification on the right side. There was a tumid neuritis of both eyes. The vision of the right eye was $\frac{1}{3}$; of the left eye, $\frac{1}{20}$. Right temporal hemianopsia homonymous was also present.

Cerebrospinal fluid was under increased tension. A lateral radiogram disclosed some opaque points over the sella turcica as well as destruction of the posterior apophysis. Our diagnosis was central tumor of this region. Nevertheless, we decided to prove our diagnosis by a cranial roentgenogram.

This we did and were fortunate in not having to deal with an epileptic crisis. The roentgenogram of the right side was normal (Fig. 2). It showed that the irrigation of the brain, both as proceeding from the sylvian group and the artery, which one very rarely sees on account of the front communicating artery. On this arteriogram (Fig. 2) we are able to follow the anterior cerebral artery, *C. A.*, the pericallosum artery, *P. C.*, the callosum marginalis artery, *C. M.*; as well as the arteries which proceed therefrom. The arteriogram of the left side showed a dislocation of the sylvian group upward in a nearly perpendicular direction (Fig. 3), so that compared with Figure 2, the sylvian group appears to be placed 2.5 centimeters higher up. Diagnosis: tumor of the foremost part of the temporal lobe. The arteriogram discloses also other quite interesting features. We see a rather small stain in the posterior part of the ascending portion of the sylvian group which is clearly dislocated, *t*. On examining the film carefully we also detect small arteries proceeding from the internal carotid moving upward toward the said stain. We also see another and smaller stain, not so distinct as the aforementioned one, in the foremost part of the sylvian group *t'*. These stains are due to the impregnation by the sodium iodide of a special tissue which does not render easy a quick backward circulation. Therefore, we decided that the growth was a rather vascularized tumor of this region, the larger part of which was located in the temporal lobe and the smaller part in the frontal lobe. Our diagnosis was meningoblastoma at the base of the left temporal region (large wing of the sphenoid bone), extending down to the posterior lower part of the frontal lobe, compressing the peduncle and the central nuclei, and, at the base of the cranium where it was probably clinging, reaching to the back clinoid process. Therefore, it was probably a rather vascularized meningioma.

Operation was carried out on December 28, 1928. Local anæsthesia was used. A large portion of the respective temporal region was cut open and the base of the tumor was explored. Little by little the lower part of the temporal lobe was made accessible. A finger inserted into the opening revealed the fact that all of the left half of the middle part of the cranium was filled by a hard tumor, very adherent at the base, and quite independent of the brain. Very carefully we isolated the tumor and as best we could removed it. The most of it could be removed (Fig. 4), but removal caused a severe hæmorrhage. We were able to check this by introducing tampons of wadding saturated in hot serum. This part of the operation was a rather long piece of work. The patient fell into a state of rather profound shock. Intravenous injections of serum were given. The pulse improved. After hæmostasis was established, we attempted an osteoplasty, but because the brain showed a tendency to herniate, we took the bone out. After the operation the general state of the patient improved a little, but during the night the pulse fell, and death ensued from heart failure.

The postmortem examination revealed some blood clots. In the left temporal lobe where the tumor had clung, we found destructive lesions which were

spreading into the posterior part of the frontal lobe. The quadrilateral bone at the base of skull was almost worn out. The anterior clinoid processes were very much reduced. The main wing of the left sphenoid bone and the left portion of the sella turcica were covered with a small amount of neoplastic tissue which it had been impossible to extract. The tumor did not go beyond the midline. Microscopic examination revealed that it was a case of "meningoblastoma of fusiform cells, fascicularly disposed."—Ch. Oberling.

The autopsy showed that our diagnosis was entirely correct.

The symptomatology in this case was such as to make us believe we were dealing with an epidemic encephalitis. Patient had a lateral trembling of the intention type, a Parkinsonian facies and crises of drowsiness, which symptoms were all in favor of the said diagnosis. It was the papillary stasis which cleared up the case. All of these symptoms, however, induced us to accept the hypothesis of a tumor of the infundibulohypophyseal region. The lateral radiogram of the head revealed two or three small calcifications in a very limited zone of the suprasellar region. The patient had a right sided temporal homonymous hemianopsia. But we did not believe that the growth involved the left temporal region because the hemianopsia was a complete one. Partial hemianopsia, more characteristic of such localizations, did not exist (Cushing). When resting, the patient had a right facial paresis of the central type. Tumors of the first third of the temporal lobe as well as tumors of the frontal lobe can produce this same facial paralysis. Clovis Vincent mentioned this fact in his report to the Réunion Neurologique in 1928.

It is necessary to point out that this was a case of a very great compression and of destruction of a part of the left temporal lobe and yet there were missing sensory aphasia, paresis of the third cranial nerves (Puusepp), lateral buzzing or ringing, etc. The roentgenograms of the brain solved the problem. We learned from them that a large tumor had invaded the left temporal lobe as well as a part of the posterior region of the frontal lobe. The cranial nerves did not offer great difficulties in the present case. The olfactory and the optic nerves were compromised. The third and fourth cranial nerves were normal, but, on the left side, were in contact with the neoplastic tissue. The sixth, a little farther away, was normal, but everyone knows that this nerve becomes sensible in cases of cranial hypertension. Close observation of the patient disclosed a passing diplopia. As to the remaining nerves only the facial was affected on the right side.

CASE 2. Tumor of the right temporal lobe. A. J., 55 years of age, railway engineer, in July, 1928, had an epileptic attack when driving an engine. Some weeks afterward he suffered another attack with clonic convulsions particularly strong on the left side of the body. At that time he noticed also a passing deafness in the right ear. In September and October he had headaches without localization. He did not vomit but was dizzy. His lower limbs were weak. Diplopia was noticed in January, 1929. At the same time he noticed impairment of vision. When he came to see us he was amaurotic. An examination of the eyes made at that time showed "tumid papillitis with exudation, more pronounced on the left side." No lues. Abdominal and cremasteric reflexes were abolished. Sensations were normal. There was loss of sight first on the left and then on the right side—exudative papillary stasis. Slight facial paresis was noticed on the right side. Hearing was rather reduced on the right side. Rinne test was positive. All other nerves were normal.

Patient was euphoric, had no just appreciation of his condition, and he continually talked of episodes of his life as an engineer.

Localization on the basis of the neurologic findings was not possible. The patient did not present a sufficient number of symptoms to permit localization. We simply verified the loss of sight, first on the left and later on the right hand side, and passing deafness on the right side. Under observation we noticed a slight diminution in hearing on the same side; a slight facial paresis on the right; also transitory, psychic disturbances. He had had an attack with clonic convulsions, more pronounced on the left than on the right side.

A simple roentgenogram of the cranium revealed nothing abnormal. The patient was given luminal for 4 days and then arteriograms were made of both sides of the head. No reaction followed. Examination of the films showed that they were necessary in order to arrive at a correct diagnosis. On the left side, the carotid system was normal. One could see the anterior cerebral artery (Fig. 5). The posterior cerebral artery, *P. C.* was plainly visible, as well as the median cerebral artery in its normal position. The sylvian group was normal. On the right side (Fig. 6) we cannot detect the anterior cerebral artery. The middle portion of the sylvian group is dislocated in an upward direction. With regard to the petrous bone it is, on the left, at a distance of 3 centimeters

and, on the right, at a distance of 6 centimeters. On this side an adventitious circulation goes down toward the middle portion of the temporal lobe, showing a stain, *T*, which can be seen very well.

Our diagnosis was meningioma of the middle part of the temporal lobe, proceeding probably from the outer part of the dura mater. From the arteriograms the size of the tumor was estimated for it had caused a very considerable elevation of the sylvian group and had provoked, at a distance, compression of the anterior cerebral artery, thus preventing the blood coming from the other side thus rendering the anterior cerebral artery visible on the left side.

Operation was done on April 19. After having cut open the right temporal region and having made the incision in the dura mater, which did not pulsate, we verified the existence of a tumor in the external middle portion of the temporal lobe, adhering to the dura mater and sinking down into the brain. We isolated and extracted the tumor. Abundant hæmorrhage was checked by means of tampons wet in hot physiologic serum.

The tumor, which had the volume of a small mandarin (Fig. 7), weighed 38 grams. The histological examination made by Mr. Ch. Oberling revealed that it was a tumor of a very special structure, giving the impression of a glioma invading the meninges. The part involving the brain was a fibrillary structure; in the part involving the meninges we were surprised at the extraordinary vascularity. This tumor appeared coarsely fibrillar and reminded us of the appearance of certain peripheric gliomata and even that of certain meningoblastomata.

In the present case we see the abundant circulation around the site of the tumor. Its localization is obvious, but we cannot detect, as in the previous cases referred to, the tumor itself. The point is that this is another kind of tumor, with considerable vascularity, connected, it is true, with the meninges but rather a kind of glioma. Thus we have another type of tumor the diagnosis of which we were able to determine by means of arteriographic study. These latter tumors, with which we have previously had some experience, do not always show the same anatomopathological characteristics. They do, however, usually have an abundant circulation—a fact of help to the surgeon in making his diagnosis.

There is a third group of tumors which can also be diagnosed—the tumors without an abundant circulation.

CASE 3. Large cholesteatoma of the right temporal lobe. A. V., 27 years of age, workman, has been under observation since 1914. At that time he complained of epileptic crises. Before that he used to have auras identical with those which always preceded his fits: sensation of heat in the entire left side of his body, and ringing in the ears. At first these auras were not followed by convulsions. The luminal had no special influence over these crises which he continued to have, more or less, with the same intensity and frequency. He was admitted to our hospital in October, 1927.

Patient fell down a flight of stairs when he was 11 years of age. Later on he had had typhoid fever and had expectorated blood. He decided to enter the hospital on account of his crises, his attacks of amnesia and especially on account of the loss of sight. He had headaches but no vomiting. Motility was normal. The crises were generalized but he turned his head to the right. At the end of one of these attacks at which we were present, he continued to have convulsions on the right side when on the left side they had already ceased. The signs of Struempell, passive flexion of the foot, and Foix-Marie were positive on the right side. The test of Oppenheim made on the left side caused the great right toe to move. The same test on the right side caused a very slight extension of the left side. On provoking the plantar reflex on the right we got the reflex of defence (shortening). Abdominal reflexes were diminished on the left side. Cremasteric reflexes were normal.

Sensation was normal, save in a zone of the abdominal region where there was a hypoæsthesia. The olfactory nerve was normal on the left side and apparently slightly compromised on the right side. The patient did not identify smells very well on this side. The second nerve was compromised. The first ophthalmologic observation made before his admission into the hospital reads: "Heavy optic papillitis with tumefaction on both sides, apparently not of recent date." Patient had a passing diplopia (6th.). The other cranial nerves were normal. We made several examinations of the auditory nerve but found no difference in the right and the left sides. Taste was normal. Cerebellar functions were normal. Patient had a nystagmus when in extreme positions; rapid oscillations when turning the eyes to the left, more pronounced but less rapid oscillations when looking to the right. He complained of not being able to do his work as before on account of his attacks of amnesia. No further mental disturbances were noticed.

The cerebrospinal fluid was under normal tension; albumen, normal; Pandy, negative, lymphocytosis 4.2; Benjoin normal; B-WR, in blood, normal.

A simple radiogram of the cranium revealed nothing abnormal. After an injection into the left carotid there was a slight dysarthria for 4 or 5 minutes, followed by transitory verbigeration. The left arteriogram was normal (Fig. 8). On the right side (Fig. 9), the carotid siphon is pulled down and projected to the front. The circulation is reduced in the upper part of the siphon. The sylvian group is considerably deviated in an upward direction. Obviously, there was a tumor in anterior

part of the temporal lobe. The slow growth of the neoplasm over a period of several years suggested a rather benign, probably extirpable tumor. After the pictures were taken the patient felt better, saying that his sight had improved and he refused to be operated on. In spite of our advice he left the hospital. One year went by and on December 10, 1928, he came again to see us. He felt worse and had shortly before ceased to work. He noticed at times a slight trembling of the left arm and hand, but on moving the arm rapidly to and fro, this trembling ceased Sight in the right eye was more reduced than in the left.

His tendinous reflexes were more or less the same; but the signs of the via pyramidalis at this time differed. On the left side there was a positive Barré, and sometimes a passive flexion of the foot, equally positive on the same side. On the right side only the signs of Babinski and of Rossolino were positive. On exciting the right plantar we observed only the extension of the great toe on the left side. On exciting the left plantar, we observed a flexion of the toes on the left side and an extension of the great toe. There continued to be a slight disturbance of the olfactory nerve on the right side, which resembled the disturbance at the first observation. The patient could identify smells perfectly well on the left side, but on the right side he could not do so or hesitated in identifying them. An ophthalmologic examination on December 14, 1928, revealed: "Neuritis on both sides, but less clear and less tumid on the left side. No diplopia." The nystagmus continued with the same characteristics and intensity as in the first observation. The patient decided to be operated upon but he died before operation, during an epileptic attack. Postmortem examination revealed the existence of a large tumor of the right temporal lobe—a cholesteatoma (Fig. 10).

In the present case the exact diagnosis would have been doubtful if it were based only upon clinical symptoms. The hemianopsia gave us, later on, new elements for the diagnosis, but this hemianopsia was different from that described by Cushing. It was an incomplete hemianopsia of the upper and the lower quadrant, and was more pronounced in the lower one.

The neurologic symptoms, as the relative anosmia on the right and the turning of the head toward the right side during the epileptic seizures, were rather suggestive of a localization on this side. The signs of the via pyramidalis detected during the first observation were, however, in favor of a localization on the left side. At the second observation, the discordance of these signs did not justify an exact conclusion.

The epileptic crisis disclosed that the convulsions still continued on the right side after they had ceased on the left side. This is a peculiar feature which we have already observed as being a sign of localization on the right side, but which until that moment made us believe in localization on the opposite side. The trembling of the left arm and hand, noted in the second observation, was another element in favor of localization on the right side.

Nystagmus with short, rapid shocks when the patient directed his look toward the left, but with greater and slower shocks when he looked toward the right, permitted no sure conclusion. The integrity of the auditory nerve was also impressive. We have already explained our opinion about the cortical centers of audition.

Again in the present case the encephalographic arterial proof helped to determine the exact site of the tumor—an impossibility in the first clinical observation and in the second observation still doubtful.

Case 4. Large tumor of the frontal lobes, larger on the left, extending to the midline, and involving the pons. A. M. S., 19 years of age, had been under observation for 15 years. When 3½ years old, he met with an accident, falling down and striking his neck against a stone. No lesions resulted but his family noticed, some days afterward, lateral oscillations of the eyeballs. Then the boy became thin and 2 months after the accident he was brought to us because he had great difficulty in making movements on the left side. He had headache and vomiting. He had had repeated lumbar punctures at intervals. Patient had improved so that he was able to go to school until 14 years old, when headache and vomiting reappeared. Again he became thin and walked with difficulty on account of the flexibility of the legs. His sight began to fail him. He had 2 generalized epileptic attacks, one of which was so severe that his family thought him dead. Two years ago, his face, body, and arms began to get fat. We made 24 applications of X-rays over the hypophysis. Last year he seemed quite well except that he sometimes had attacks of hiccoughs. Headache and vomiting disappeared. There was complete blindness of the left eye, but perception to light in right.

Present examination revealed adiposity of the body, arms, and face where the pilose system was very little developed. The back and lower limbs were normal. Hair of the pubis and lower limbs was normal. On the thighs and legs there was even a certain hypertrichosis for his age. From this point of view, the contrast between the upper and lower parts of the body was a remarkable one. The testicles

Fig. 2. Right arteriogram of brain, Case 1. *S.C.*, Carotid siphon; *G.S.*, sylvian group, normal; *C.A.*, anterior cerebral artery; *P.C.*, pericallosum artery; and *C.M.*, callosum marginalis artery in normal positions.

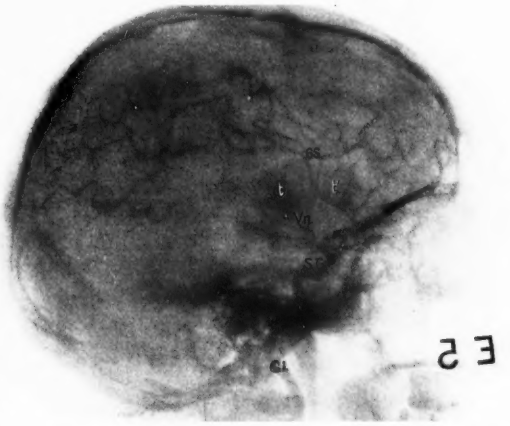


Fig. 3. Left arteriogram of brain, Case 1. Carotid siphon normal. *G.S.*, sylvian group considerably raised. *t.t'.*, Tumor. *Vn.*, vessels of the new formation supplying the tumor.

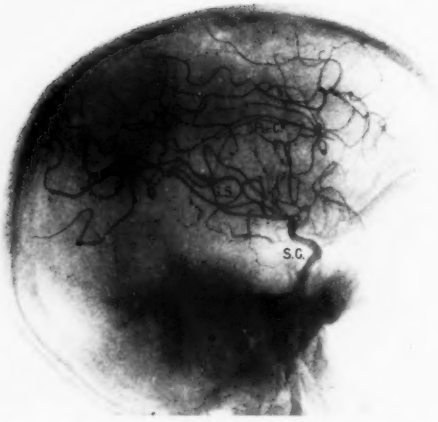
were normal. He had erections and had not lost the libido sexualis. Walking was impossible on account of flexion of the legs. It was impossible to reduce this flexion on account of the pain and heavy muscular contractions which were brought about by any such experiment. Movement of the upper limbs was normal, but were accompanied by trembling. The tendinous reflexes were brisk and prompt, both in the upper and lower limbs. The cremasteric reflex was normal on the right side and abolished on the left side. There was complete anosmia on the left. On the right side, the patient recognized, at times, some smells. There was complete amaurosis on the left side; perception to light on the right side. There was papillary stasis and afterward secondary atrophia of the optic nerves. There was slight facial paresis of the central type on the left side. There was almost complete deafness on the left side. On the right, the patient does not hear well. The remaining cranial nerves were normal. No adiadochocinesis was present. Some nystagmiform movements were noted, especially when the patient looked to the left. There was considerable euphoria. Patient was a little childish, but showed no mental confusion. Examination of the cerebrospinal fluid showed tension continuously much increased, at times xanthochromic; albumen increased, Pandy (+ + — —), lymphocytosis 3 to 4 per cubic millimeter. A simple roentgenogram showed the sella turcica destroyed. The right arteriograph (Fig. 11) showed the pericallosum artery considerably raised. The extended anterior cerebral artery made a curve with concave toward the front. On this side was visible an upper circulation seeming to encircle the neoplasm. The left arteriogram (Fig. 12) revealed considerable lowering of sylvian group and disappearance of the frontal lobe circulation.

Evidently, this was a case of a very large tumor, without a very appreciable circulation, of the left frontal lobe, extending beyond the midline and invading the right frontal lobe. Its site must have been on the bone and it must have raised the corpus callosum considerably. A tumor of this size and this position was likely to involve the middle part of the cranium.

The patient's condition was not very serious but he insisted upon being operated upon. After explaining the circumstance to his family, the operation was carried out in July last.

After cutting and laying open the left frontal lobe, we found the tumor at once at the base of the frontal lobes, more developed on the left side and extending toward the right. We opened it and found therein a cyst containing gelatinous matter. The state of the

Fig. 4. Tumor removed in Case 1.



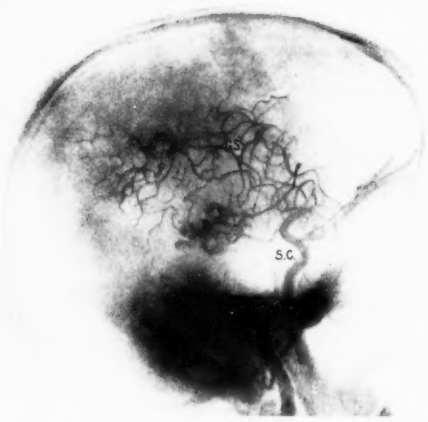


Fig. 5. Left arteriogram, Case 2. The pericallosum artery, *Per. Ce.*, is in its normal position.

Fig. 6. Right arteriogram, Case 2. The sylvian group *G.S.*, is considerably raised in its middle portion. The circulation of the tumor, *T*, is visible in the middle part of the temporal lobe. The tumor was removed and the patient was cured.

patient did not permit us to go farther. The skull bone was very thin. Patient died in the evening of the day of operation.

The postmortem examination revealed an enormous tumor (Fig. 13), nestled at the bottom of the frontal lobes, more on the left than on the right side and extending backward as far as the pons.

Case 5. Tubercle of the base on the level of the fore part of the temporal lobe. Manuel J. M., 23 years of age, farmer. Patient had severe headaches in August, 1928, and had vomited for 1 month. On being admitted to our hospital on December 19, he complained still of severe headache and of sensations of nausea. A week after the beginning of these cephalalgias he noticed that his sight became very much reduced on both sides. He had had no difficulty with his ears save some ringing on both sides, sometimes of great intensity. He had never had attacks of disturbance in movements. General state was bad and he was anæmic. He had a weak pulse with bradycardia. To provoke the patellar reflexes it was necessary to use the Jendrassick maneuver. The achillean reflexes were unobtainable. The tendinous reflexes in the upper limbs were also unobtainable. The plantar reflexes were present in flexion. Abdominal and cremasteric reflexes were a little more pronounced on the left side. The patient appeared slightly apathetic and somewhat reserved. The percussion of the head revealed that he felt the same pain on both sides. The cranial nerves were all normal save the second; "vision very reduced, tumid and hæmorrhagic neuritis."

Fig. 7. Tumor removed in Case 2.

An examination of the cerebrospinal fluid showed tension very much increased, the fluid pouring out without interruption. Albumin was very much increased, Pandy (+ + + —), lymphocytosis 2.9 per cubic millimeter, Benjoin 00112, 32223, 00000.0. Urine was normal. The roentgenograms revealed the obliteration of the clinoid processes.

On the right arteriogram (Fig. 14) the aspect was more or less normal, but the origin of the sylvian group appeared slightly raised.

In the arteriograph of the left side (Fig. 15), the sylvian group appeared suddenly raised by about 3 centimeters above its normal position. The posterior temporal artery, *T. P.*, descended rapidly to its normal position. The artery of the curved fold

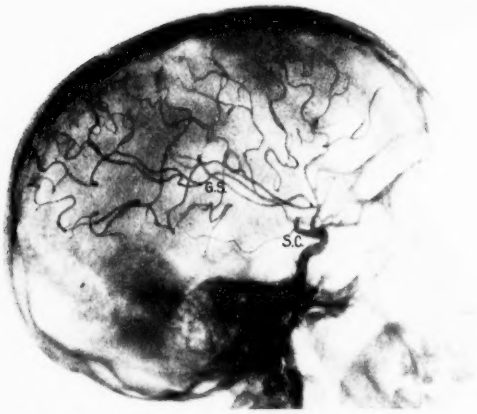


Fig. 8. Left arteriogram, Case 3. Normal.

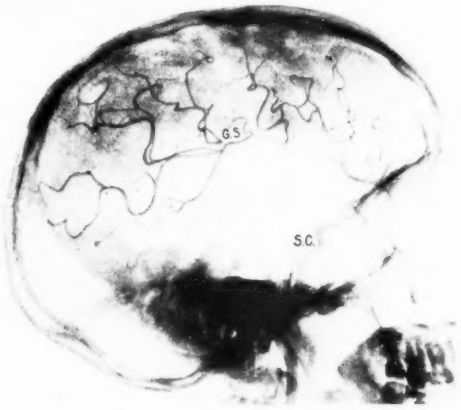


Fig. 9. Right arteriogram, Case 3. There is considerable elevation of the sylvian group, *G.S.*, in the anterior part. The carotid siphon *S.C.* is nearly destroyed. There was considerable loss of circulation in the fore part of the brain. Cholesteatoma of the anterior part of the temporal lobe.

remained much more raised. The diagnosis we made was: "probable tumor on the level of the former part of the left temporal lobe, deeply set and probably clinging to the base of the cranium going up to, or even a little beyond, the middle line." The existence of the tumor on the left side and in the temporal region was not to be doubted. It could readily be verified by a glance over the two arteriograms (Figs. 14 and 15). Besides, the tumor was evidently deep in the temporal lobe, because the posterior temporal artery, *T. P.*, which is the most superficially placed one, descended rapidly to its normal position. This meant that quite likely the external part of the temporal lobe was not affected. The tumor was supposed to be situated at the base of the cranium, pressing on internal part of temporal lobe with its arteries. It probably extended to the midline.

Operation was done on January 18, and local anæsthesia was used. A musculocutaneous shred in the left temporal region was cut open. In order to get well down to the temporal hole we began the temporary resection of the zygomatic process. We resected the temporal shell as close to the base as possible. No pulsations of the dura mater were noticed. Incision revealed great tension. Glucose solution was injected. Extraction of 25 cubic centimeters of cerebrospinal fluid by means of the lumbar puncture was done. The brain cortex was found to be normal. We immediately explored the base by introducing a finger between the brain and the base of the cranium. We detected at once, approximately within an inch from the origin of the sylvian fissure and at a distance of about 2 or 3 centimeters from the periphery, a hard tumor (Fig. 16) not adherent to the dura mater. The tumor was deeply set and seemed to extend to the middle line. Slowly we isolated it. The histological examination showed that it was a tuberculoma.

This patient remained in our hospital until May, 1930, i.e., 1 year and 4 months after the operation. He is getting on very well, his sight has improved to such an extent that we have authorized him to take up his usual work again. The last ophthalmologic examination, made on April 17, 1930, discloses that "The right eye detects the fingers at a distance of 1 meter. The vision of the left eye is greatly improved. In December, 1928, the patient did not see the fingers unless they were placed close to the eye; on February 13, 1929, he was able to see them on the left at a distance of 5 meters. The optic nerves and the vessels of the retina are in approximately the same state."

Fig. 10. Cholesteatoma of the right temporal lobe. Case 3.

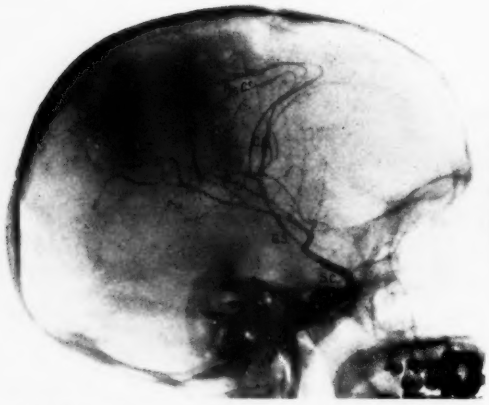


Fig. 11. Right arteriogram, Case 4. The origin of the sylvian group, *G.S.*, is lowered. The anterior cerebral artery, *C.A.*, is stretched and bent; the pericallosum artery, *Per. Cc.*, is considerably raised to the level of the "knee" of the corpus callosum which also is considerably raised. There is scanty circulation of the tumor.

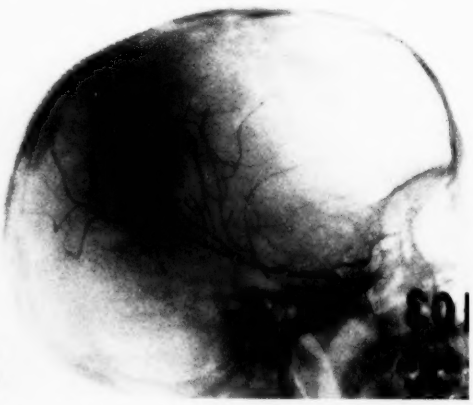


Fig. 12. Left arteriogram, Case 4. The sylvian group, *G.S.*, is greatly lowered.

The diagnosis was confirmed in all its particulars by the operation. This case is specially interesting, as there were no factors on which to determine localization. The neurologic observation revealed nothing, but the roentgenogram showed that the anterior and posterior clinoid apophyses were destroyed. The patient had no symptoms caused by disturbances of the infundibulohypophyseal region. It is well known that the clinoid processes can be destroyed by a tumor located at some distance from them. The flattening of the sella turcica as well as the complete disappearance of the clinoid processes was also in favor of an extrasellar tumor (John Camp). Béclère says in his report to the ninth Réunion Neurologique: "Whatever the site of the extrasellar tumor in the interior of the cranium may be, and be they near or distant, the deformaties brought about by them have the same general aspect and do not in themselves make possible localization of these tumors." In the present case we had a juxtasellar tumor placed behind the posterior clinoid process, which was clearly revealed by the arterial encephalogram. The diagnosis was absolutely precise and the operation in the region indicated was conducted in such a way as to permit extraction of the brain tumor. Successful operations upon these tumors of the brain base are rather rare, except in the case of tumors of the hypophyseal region. Without an accurate diagnosis, it is always very difficult to extract them.

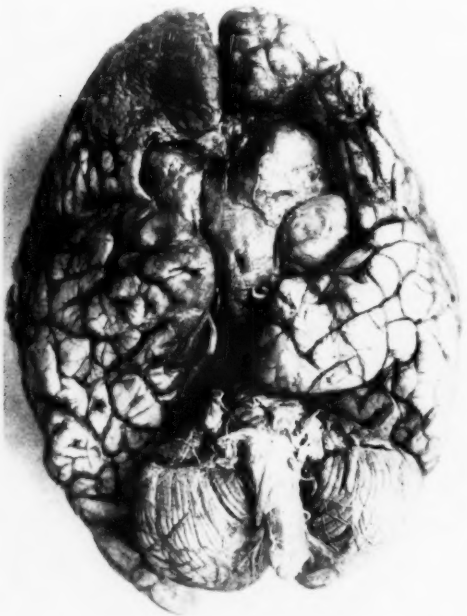
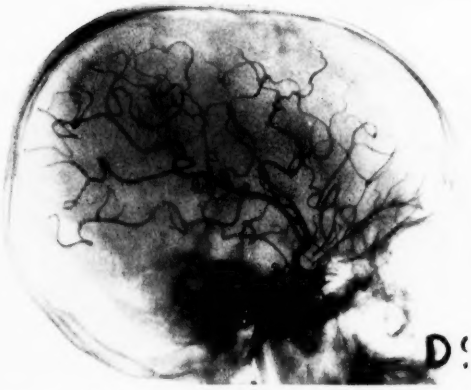


Fig. 13. Brain from Case 4. A piece, *P.*, of considerable proportions has been removed from the left side (upper right side of picture).



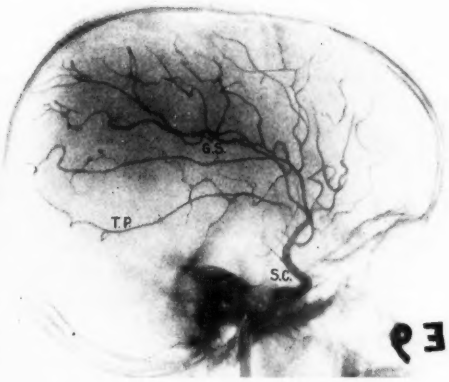


Fig. 14. Right arteriogram, Case 5. The carotid siphon, *S.C.* is normal. The sylvian group, *G.S.*, is slightly raised in the middle part.

Fig. 15. Left arteriogram of Case 5. The carotid siphon is stretched out and the sylvian group, *G.S.*, is raised. The arteries of the curved fold and the posterior parietal artery are considerably raised. The temporal arteries fall rapidly down to their normal position. Tuberculoma of the mid portion of the temporal lobe reaching to the midline. Removed. Cured.

This case has shown us that a brain tuberculoma can be extracted and that the patient can recover his health (Fig. 17). We have been convinced that the prognosis in brain tuberculomata is not so bad as that of large cerebellar tuberculomata.

In the present observation, which we believe is unique in the medical literature, a large tuberculoma of the brain base was successfully extracted and the patient recovered. The patient was under observation for 18 months and left the hospital in good health. Such a favorable result cannot help but encourage us to ablate at least tuberculomata of the brain. We must remember, however, that we could not have been so successful in extracting the tumor so easily had it not been for the diagnostic precision obtained through the encephalographic films.

The film revealed the absence of circulation in the last two tumors, which belong to the third group of neoplasms in which the arteriographs of the brain have made possible the localization of the growth, i.e., in cholesteatomata, hydatid cysts, tuberculomata, some gliomata, etc.

SUMMARY OF OBSERVATIONS

When we began our studies in arterial encephalography, we gave special attention to the dislocation of the sylvian group as we believed they were especially capable of revealing the existence of a subjacent tumor. And this for two reasons: (1) the sylvian group is

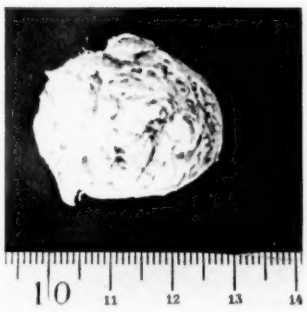
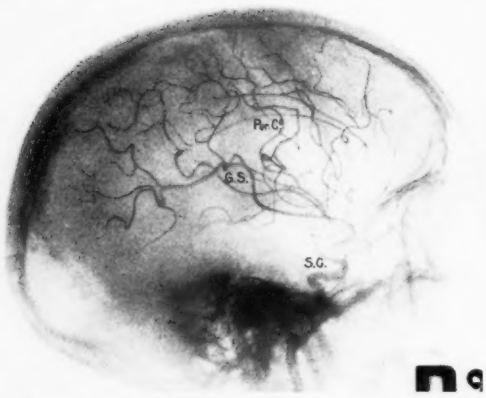


Fig. 16. Tuberculoma removed.

Fig. 17. Patient 1 year after operation.



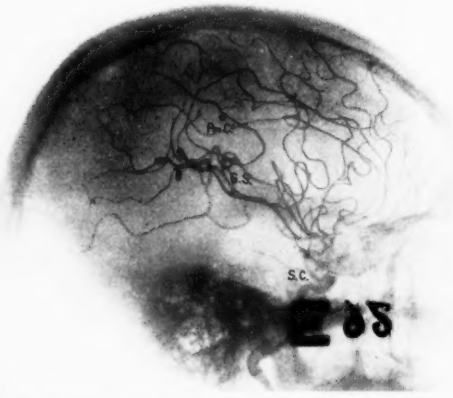


Fig. 18. Right arteriogram, Case 6. The carotid siphon, *S.C.*, is normal. The sylvian group is raised slightly in the mid portion. The *Per. Ce.*, pericallosum artery is considerably raised in the posterior part.

Fig. 19. Left arteriogram, Case 6. The carotid siphon, *S.C.*, is normal. The sylvian group, *G.S.*, is raised slightly in the middle part. The circulation of the tumor on the level with the middle part of the sylvian group corresponds to the pineal gland. The pericallosum artery, *Per Ce.*, is visible also on this side and is raised toward the rear.

constantly visible, normally showing the same direction and similarity of constitution; (2) the first arteriograms made did not reveal any of the aspects later discovered in the course of our experiments, namely: visibility of the adventitious circulation of some tumors and visibility, in certain cases, of the anterior cerebral artery and its ramifications.

In the dislocation of the sylvian group we have been able, so far, to locate and make accurate diagnoses in 18 cases of brain tumors, and of these 14 were confirmed by the operation, the 4 remaining not having been operated upon. The direct visibility of the arteries was observed in 13 cases; of these, 9 were operated upon.

We have recently tried to determine why the anterior cerebral artery is not always visible and we were able to come to some conclusions which appear to us to be of the utmost importance in making a diagnosis.

When there is a tumor of certain volume in one of the brain halves, it is sometimes possible to see the anterior cerebral artery on the opposite side. Through compression the tumor prevents the regular circulation and the anterior communicating vessel ceases to take the blood from the compromised half of the brain to the opposite side because of the diminution in pressure in the anterior cerebral artery of that side. The same is true when opaque liquid is introduced into the artery by means of an intracarotid injection. When this liquid is injected on the opposite side, as the blood does not come from the side where the tumor exists, we can see, as a rule, not only the sylvian group but also the anterior cerebral artery where the concentration of the iodide is not reduced by being mixed with the blood coming through the communicating artery. This point—the unilateral visibility of the anterior cerebral artery—is of certain value in making a diagnosis.

In the arteriograms obtained by the technique of temporarily stopping the blood in the internal carotid, we sometimes see the anterior cerebral arteries on both sides. This fact at first seemed to be due simply to technique—an injection made more quickly—and it puzzled us for a long time. Now we are convinced that the phenomenon of visibility of the anterior cerebral artery on both sides can be brought about, in very exceptional cases, by an abnormality of the brain.

The anterior cerebral artery must always be visible when the corresponding artery of the opposite side does not cause an overflow of blood into it during the injection of iodide of sodium so as to reduce the concentration of this latter by more than 8 to 10 per cent. But

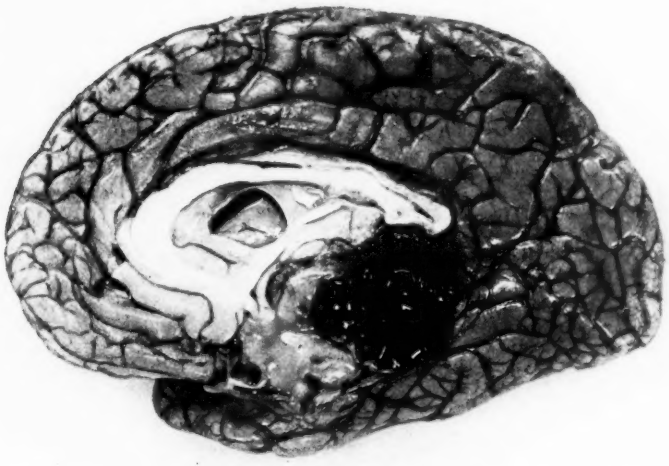


Fig. 20. Tumor of the pineal region, right half. The splenium of the corpus callosum is elevated, thus causing the elevation of the terminal part of the pericallosum artery in the posterior part.

such cases of anatomical abnormality of the anterior communicating artery (very reduced size) are rather rare. Consequently, it was necessary that there should be some pathological reason to account for the relatively frequent visibility of the anterior cerebral artery on both sides. After prolonged observations, we came to the conclusion that considerable dilatation of the ventricle or the presence of a tumor compressing the anterior communicating artery, apart from the two anterior cerebral arteries, rendering it difficult for the blood to pass from one to the other owing to the stretched and decreased size of the communicating artery, must be the reason of the visibility of the two anterior cerebral arteries. Tumors of the central region of the brain, for instance of the third ventricle, of the pineal region, and of the quadrigeminal tubercles must fall in this class. As soon as we obtained some proof that this hypothesis was undoubtedly true, we tried to utilize dislocations of the arteries connected with the anterior cerebral artery as a means of diagnosis.

The importance of this new interpretation of arteriograms seems to us to be of the utmost importance inasmuch as tumors of the central regions offer, as a rule, very deficient clinical symptomatology.

The anterior cerebral artery entering the interhemispherical cleft and furnishing, by its convexity, the orbital and frontal arteries, adjusts its course to the corpus callosum going partly around it and in general follows the channel between the corpus callosum and its circumvolution, i.e., the so-called sinus of the corpus callosum. Very often its forward part goes around the corpus callosum for a distance, passes over the corpus callosum circumvolution, and descends down to the channel or sinus of the corpus callosum, where it enters in order to reach the splenius.

In this part of its course in which it is called the posterior cerebral artery, it ramifies into various branches which lead to the circumvolutions of the internal face of the brain. On going around and through the upper portion of the brain, these branches also irrigate in part the convex portion of the brain half way to the calcarate fissure. In the arteriograms the median cerebral artery is situated over the posterior cerebral artery.

CASE 6. Visible tumor of the pineal gland. Henrique S. G., 34 years of age, workman, March, 1930, came to consult us at our Neurological Department. He had had severe headaches which began some 3 months before he came to see us, these headaches were more intense in the occipital region. He had

attacks of vomiting. One month after the headaches began, he noticed impairment of sight and hearing. When observed for the first time he was practically blind. Vision was reduced by 5/100 on the right side and more reduced still on the left side. Deafness, at that time already very pronounced, increased rapidly until it became complete.

Right patellar reflex was abolished, the left one very weak. Achillian reflexes were abolished on both sides. Tricipital and radial reflexes were weak on left and abolished on right side; abdominal and cremasteric reflexes, normal; plantar reflexes noticed in flexion. No signs of the via pyramidalis.

The left eye showed "a heavy papillary stasis with hæmorrhages. In the end complete amaurosis." As to the seventh cranial nerve, at times a slight facial paresis of the central type was noticed on the right but this disappeared without leaving a vestige. As to the eighth nerve, there was a very pronounced diminution of audition at the time he entered the hospital, which some time later became complete. Cerebellar functions were normal. No vertigo or nystagmus was found. Psychical disturbances were slight. The patient said he had a continuous desire to urinate, but that it was not necessary to do so. Deafness and amaurosis prevented us from making a thorough examination of his mental state. We were, however, under the impression that there was a pronounced psychical deficiency. He used to utter somewhat strange and stereotyped phrases. In the terminal phase torpor and drowsiness were present.

The right arteriogram (Fig. 18) was normal in the region of the sylvian group. We could detect the anterior and the pericallosum artery. The left arteriogram (Fig. 19) showed considerable vascularity in the posterior half of the sylvian group which appeared in its normal position. On this side we could also see the anterior cerebral artery with its ramifications. On both arteriograms the pericallosum artery was raised in the posterior part.

Taking especially into account the marked vascularity in the left sylvian group, we made a diagnosis of a very vascularized deep tumor of the middle part of the brain, on the level of the third ventricle. We believed that it was a central one as it did not dislocate the sylvian group on either side, but it did raise the splenius of the corpus callosum. We decided that the tumor was a vascularized glioma.

The operation was carried out on March 28, 1930. Because it was impossible to reach the region of the tumor, we resolved to do a decompression. Patient showed slight improvement at first but became worse and died a month after the operation.

The postmortem examination revealed the existence of a large, very vascularized tumor of the pineal gland and the corpora quadrigemina, the size of a mandarin (Fig. 20). The tumor clung to the back wall of the third ventricle and was situated under the splenium.

The diagnosis we had made was fairly accurate, although this was the first case we had had of a tumor in this region. Clinical symptoms which might enable one to localize the growth were absolutely missing. The patient had had no trouble which might be considered as the result of the destruction of the pineal gland. We can say almost the same referring to the corpora quadrigemina.

The histopathological examination made in the Anatomopathologic Institute of Paris, by Prof. Ch. Oberling, revealed that it was a case of ependymoma.

The arteriographic diagnosis of this case, one of the most interesting of our collection, is worthy of some consideration. The visibility of the tumor due to the vascularity on the level of one of the sylvian groups revealed a curious aspect in the circulation of brain tumors. In meningoblastomata, diagnosed by means encephalographic proof, we have found that these tumors have not only a circulation arising from the meningeal arteries, but also an accessory circulation proceeding from one of the branches of the internal carotid, which becomes visible in the arteriograms.

In the last case described only one of the sylvian groups supplied the tumor with an abundant system of blood vessels, although both sylvian groups were at the same distance from the neoplasm. The first arterial neoformation caused the unilateral circulation of a central tumor.

Were there also vessels proceeding from the posterior cerebral artery? This artery becomes visible only in abnormal cases, when the posterior communicating artery does not really exist as it is reduced to an insignificantly small size. In this case it is not visible. Therefore, we do not know whether it contributed to the vascularity of the tumor, although this does not seem to us very probable. Vascularity of tumors, especially of brain tumors, through arteriography has been found a valuable means of study.

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A STUDY OF THE EFFECTS OF DIVISION OF THE CERVICAL ŒSOPHAGUS OF THE DOG

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HADEN and Orr (2), Wangensteen and Chunn, Andrus and Donnelly have found that complete obstruction of the œsophagus of the dog produces death in from 1 to 3 days. Studies on the blood after occlusion of the œsophagus showed that there is usually an increase in the non-protein nitrogen and urea nitrogen and a decrease in the chloride content. These alterations were not sufficiently constant or great to indicate that they were responsible for the early death. Andrus and Donnelly state that dogs with fistulæ of the œsophagus die in almost as short a time as those in which the œsophagus is simply obstructed. These findings suggest that the loss of fluid causes the death of dogs after complete occlusion of the œsophagus. Pavlov was able to keep dogs alive which had fistulæ of the œsophagus by feeding them through a tube placed in the stomach. He states: "In the year 1889, we performed the operation of œsophagotomy on a dog already possessing a gastric fistula; that is to say, we divided the gullet in the neck, and caused both its divided ends to heal separately into an angle of the skin incision. We thereby accomplished the complete anatomical separation of the cavities of the mouth and stomach. Dogs so operated upon recover perfectly with careful nursing and live many years in the best of health. In feeding, their food must naturally be brought directly into the stomach."

If the loss of fluid as saliva is responsible for the death of animals after the œsophagus is obstructed, a concentration of the blood, a decrease in the blood volume, and a decrease in the content in water of the tissues of the body would be expected. It was for the purpose of studying these points that these investigations were undertaken. For purposes of comparison, similar studies were made as to the effects of food and water deprivation and as to the effects of the graded removal of blood plasma and of whole blood while the animals were deprived of food and water.

METHODS

Dogs were used in all experiments. The dye method which was described by Keith, Rowntree and Geraghty was employed in determining the blood volume and plasma volume. The hæmoglobin was determined by the Newcomer method (5) with a Bausch and Lomb hæmoglobinometer. The chloride content was determined by the method of Whitehorn (8). Samples of blood and muscle were obtained at the beginning and at the termination of the experiments for studies on the content in water. Blood was withdrawn from the femoral vein. Muscle was obtained from the pectoral and one of the flexor muscles of the thigh at the beginning of the experiments and from symmetrical sites on the opposite side of the body at the termination. The specimens of muscle which usually varied in weight from 1 to 2 grams were placed in beakers of known weight and cut into small pieces in order to facilitate drying. After weighing the beaker containing the blood or muscle, it was placed in an oven, the temperature of which was kept at as nearly 105 degrees centigrade as possible. After 48 hours, it was again weighed, and the content of the tissues in water and solids was determined.

During the operations which were performed in order to occlude the œsophagus, the animals were anæsthetized with ether. The control determinations were performed before the anæsthetic was begun. The œsophagus was exposed and isolated in the cervical region. Two ligatures of heavy tape were placed at a distance of about 2 centimeters above and below the level at which the œsophagus was to be divided. Two ligatures of catgut were placed between these and the œsophagus was divided. The animals were observed from time to time

TABLE I.—THE EFFECTS OF DIVISION OF THE ŒSOPHAGUS

Experiment	Time of determinations	Wt. dog kg.	Hæmoglobin per cent	Red blood cell count	Plasma volume c.cm.	Blood volume c.cm.	Blood choride content mgm. per 100 c.cm.	Remarks
1	Control	8.11	85	6,830,000	537	814	554	Died approximately 63 hours after operation
	46 hrs. 30 min. after operation	6.85	92	7,680,000	392	695	558	
	50 hrs. after operation	6.71	95	7,490,000	369	637		
2	Control	6.66	90	7,640,000	425	723	548	Died approximately 56 hours after operation
	46 hrs. after operation	5.62	108	8,620,000	334	719	541	
	48 hrs. after operation	5.55			252	495		
3	Control	14.7	105	7,680,000	759	1503	526	Died approximately 60 hours after operation
	24 hrs. after operation	13.97	128	9,470,000	500	1222	449	
	48 hrs. after operation	13.3	135	9,970,000	501	1184	441	
4	Control	17.0	95	7,170,000	882	1582	515	Died approximately 60 hours after operation
	24 hrs. after operation	16.1	100	8,290,000	710	1359	467	
	48 hrs. after operation	15.05	100	7,900,000	592	1313	465	
5	Control	16.33	88	6,610,000	900	1668	479	Died 40 hours after operation
	24 hrs. after operation	15.0	90	6,800,000	657	1263	462	
6	Control	12.28			699	1025		Died approximately 60 hours after operation
	Control	12.52	78	4,680,000	680	974	508	
	20 hrs. after operation	10.9	80	5,050,000	476	715	573	
	43 hrs. after operation	10.29	85	6 200,000	452	682	546	Mean blood pressure 97 mm. hg.
7	Control	14.7	105	7,680,000	759	1574	526	Died approximately 38 hours after operation
	24 hrs. after operation	13.97	128	9,470,000	526	1240	449	
8	Control	17.0	95	7,170,000	884	1585	515	Died approximately 38 hours after operation
	23 hrs. after operation	16.1	100	8,290,000	710	1358	467	

until they appeared to be in very poor condition, the blood pressure was determined, and the studies which had been performed before the operation were repeated.

Since these animals were unable to swallow food or water, studies were performed upon other dogs which were simply deprived of food and water for 80 hours. This was the upper limit of the duration of the experiments in which the œsophagus was divided. After the control determinations had been performed, the dogs were anæsthetized for 1 hour by ether as were those in which the œsophagus was divided. Samples of muscle were obtained while the animals were anæsthetized. No food and water was given for 80 hours and the studies were repeated.

In the next group of experiments, food and water were prohibited and blood plasma which equalled ½ of 1 per cent of the body weight was removed at 8 hour intervals in some experiments and at approximately 12 hour intervals in others. Determinations were made at the beginning and end of the experiments. These experiments were usually of shorter duration than were those in which the œsophagus was divided. At 8 or 12 hour intervals, whole blood which equalled 1 per cent of the body weight was removed from the femoral artery. This was defibrinated and centrifuged and red blood cells, plus enough plasma to equal one-half of the volume of blood that had been removed, were re-injected. Plasmapheresis was continued at the stated intervals until the condition of the animal became alarming. At that time, the blood pressure was determined and the last studies were performed.

In the next group of experiments, the animals were deprived of food and water, and whole blood which equalled 0.5 per cent of the body weight was removed at approximately 12 hour intervals. Studies were performed

TABLE II.—THE EFFECTS OF DIVISION OF THE ŒSOPHAGUS ON THE WATER CONTENT OF BLOOD AND MUSCLE

Experiment	Time of observation	Wt. dog kg.	Mean b.p. mm. hg.	Blood water content per cent	Pectoral muscle water content per cent	Flexor muscle thigh water content per cent
1	Control period			78.85	73.54	71.81
	48 hrs. after division œsophagus		90	77.60	70.00	67.70
2	Control period			79.70	75.45	74.58
	48 hrs. after division œsophagus		60	78.20	72.25	72.90
3	Control period			82.62	77.60	77.82
	48 hrs. after division œsophagus		60	82.50	73.90	73.70
4	Control period	9.50		81.20	75.10	75.20
	24 hrs. after division œsophagus	8.20		78.20	73.15	73.00
5	Control period	14.90		77.9	75.9	74.7
	48 hrs. after division œsophagus	13.80	70	75.35	73.75	72.4

TABLE III.—THE EFFECTS OF FOOD AND WATER DEPRIVATION FOR EIGHTY HOURS

Experiment	Time of determination	Wt. dog kg.	Mean b.p. mm. hg.	Hb. per cent	Red blood cell count	Plasma volume c.cm.	Per cent loss plasma volume	Blood volume c.cm.	Per cent loss blood volume	Chloride content mgm. per 100 c.cm.	Per cent in water		
											Blood	Pectoral muscle	Flexor muscle thigh
1	Control	13.41		73	4,680,000	873		1460					
	Control	13.03		80	5,060,000	797		1416		516	79.01	63.9	68.75
	80 hrs. later	11.89	120	90	6,800,000	586	29.82	1172	18.50	674	78.99	63.8	68 20
2	Control	9.21		80	6,430,000	614		1106					
	Control	9.14		82	6,250,000	510		1034		526	78.8	71.85	75.0
	80 hrs. later	8.0	150	95	8,000,000	394	29.90	745	30.40	681	78.8	72.22	72.3
3	Control	12.62		85	6,850,000	806		1440		579	79.2	73.95	73.55
	80 hrs. later	10.58	150	90	8,420,000	739	8.32	1320	8.34		77.9	70.80	71.75
4	Control	16.80		90	7,000,000	964		1606					
	Control	16.77		90	7,000,000	950		1583		600	79.8	73.5	73.0
	80 hrs. later	15.15	150	100	10,050,000	748	21.80	1246	21.90	688	80.2	71.5	72.7

An interval of 24 hours separated the control studies. The animals were given small amounts of morphine at the time of the determinations.

before the first removal of blood and after the blood pressure had been reduced to a fairly low level by the loss of blood. These experiments were of slightly longer duration than were those in which the œsophagus was divided.

RESULTS

Division of the œsophagus. The length of time which elapsed between the division of the œsophagus and the last determinations varied from 23 to 48 hours. The blood pressure was not determined in most of these experiments, but the pulse rate was very fast and the condition of the animals very poor at the time of the last determinations. The animals lost as an average 10.23 per cent of the body weight during the period of observation. The hæmoglobin and the red blood cell count increased in all experiments. There was a marked decrease in the blood volume in all experiments and most of the decline was due to the reduction in the volume of plasma. In most of the experiments there was some reduction in the chloride content, but in no instance was this very great. The content in water of both blood and muscle was decreased in all experiments in which it was determined. The results of all of the experiments on division of the œsophagus are given in Tables I and II.

TABLE IV.—THE EFFECTS OF FOOD AND WATER DEPRIVATION AND OF THE REMOVAL OF BLOOD PLASMA

Experiment	Time of determination	Wt. dog kg.	Mean b.p. mm. hg.	Hb. per cent	Red blood cell count	Plasma volume c.cm.	Per cent loss plasma volume	Blood volume c.cm.	Per cent loss blood volume	Chloride content mgm. per 100 c.cm.	Amount plasma removed in percentage body weight	Total amount removed in percentage body weight
1	Control	11.8		88	6,800,000	562		1082		541	0.5 per cent every 12 hrs.	2
	36 hrs. later	11.0	104	100	8,000,000	469	16.5	938	13.3	541		
2	Control	11.04		82	6,780,000	575		992		608	0.5 per cent every 12 hrs.	2
	36 hrs. later	9.19	84	98	7,900,000	364	36.6	628	36.7	596		
3	Control	12.76		80	6,930,000	697		1245		663	0.5 per cent every 12 hrs.	2.0
	36 hrs. later	10.93	76	90	8,000,000	548	21.4	1169	6.1	621		2.5
	48 hrs. later	10.73	78	95	8,680,000	480	32.7	1008	19.5	608		
4	Control	13.46		78	5,270,000	682		1065		598	0.5 per cent every 12 hrs.	2
	36 hrs. later	12.35	66	80	7,050,000	398	41.7	664	37.7	610		
5	Control	7.1		87	6,000,000	532		887		574	0.5 per cent every 8 hrs.	2
	25 hrs. later	6.4	60	90	7,080,000	400	24.8	701	20.9	510		
6	Control	8.5		105	8,280,000	578		1032		541	0.5 per cent every 8 hrs.	2
	25 hrs. later	7.83	88	105	9,280,000	314	45.7	569	44.9	495		
7	Control	12.1		90	5,930,000	770		1310		514	0.5 per cent every 8 hrs.	2
	25 hrs. later	11.18	52	87	6,800,000	458	40.5	850	35.1			

In the first four experiments, the dogs were given morphine in small amounts at the time of the determinations. In the last three experiments, the animals were deeply anesthetized by sodium barbital. The content in water of blood and skeletal muscle was determined in most of these experiments, and it was usually slightly lower at the termination of the experiments than during the control periods.

Food and water deprivation. In the experiments in which the animals were deprived of food and water for 80 hours, the loss in weight (11.54 per cent) was approximately the same as in the experiments in which the œsophagus was divided. However, the average duration of the latter experiments was only 40 hours. The blood pressure was normal at the end of the period of food and water deprivation. The hæmoglobin and red blood cell count increased in all experiments. The blood volume and plasma volume decreased. The decline in the plasma volume was definitely less than was found in the experiments on the œsophagus. The content in chlorides increased in the three experiments in which it was determined. There was practically no alteration in the water content of the blood. In seven of the eight determinations, the water content of muscle decreased slightly. The results of these experiments are given in Table III.

Food and water deprivation and removal of blood plasma. The average duration of the experiments in which blood plasma was removed while the animals were deprived of food and water was 33 hours. The total amount of blood plasma that was removed equalled 2 per cent of the body weight in six of the seven experiments and in the remaining experiment it equalled 2.5 per cent. The mean blood pressure at the termination of the experiments varied from 52 to 104 millimeters of mercury. In six of the seven experiments, it was less than 90 millimeters of mercury. The general condition of the animals appeared to be approximately the same as in the experiments in which the œsophagus was divided. In these and in all of the experiments reported here, the last studies had to be performed before the animals became moribund, because otherwise the removal of blood preparatory to the injection of the dye might have resulted in death before the blood sample containing the dye had been collected. The loss in body weight (10.53 per cent) was approximately the same as in the experiments on the effects of division of the œsophagus. The red blood cell count increased in most of them. The plasma

TABLE V.—THE EFFECTS OF FOOD AND WATER DEPRIVATION AND OF HÆMORRHAGE

Experiment	Time of determination	Wt. dog kg.	Mean b.p. mm. hg.	Hb. per cent	Red blood cell count	Plasma volume c.cm.	Per cent loss plasma volume	Blood volume c.cm.	Per cent loss blood volume	Chloride content mgm. per 100 c.cm.	Per cent in water			Amount blood removed in percentage body weight	Total amount removed in percentage body weight
											Blood	Pectoral muscle	Flexor muscle thigh		
1	Control	12.05		78	6,000,000	606		926		622	84.10	75.20	74.20	0.5 per cent every 12 hrs.	3.0
	60 hrs. later	10.84	0	45	3,250,000	430	29.0	590	36.3	659	87.25	71.65	72.10		
2	Control	14.06		88	7,500,000	651		1075		571	77.70	73.80	74.85	0.5 per cent every 12 hrs.	3.0
	60 hrs. later	12.11	110	68	5,120,000	531	18.41	863	19.71	641	81.00	73.05	74.15		
3	Control	11.93		70	4,650,000	685		1224		501	80.55	73.90	75.40	0.5 per cent every 12 hrs.	3.0
	60 hrs. later	10.52	98	55	2,860,000	549	19.85	855	30.3	693	82.70	72.80	73.75		
4	Control	13.80		74	5,650,000	730		1115		592	82.90	73.40	74.90	0.5 per cent every 12 hrs.	3.0
	60 hrs. later	12.26	112	58	3,800,000	447	48.75	585	47.55	712	85.70	72.85	73.32		

volume and the blood volume decreased. The decrease in the plasma volume was approximately the same as in the experiments in which the œsophagus was divided but the decrease in the blood volume was greater. The content in chlorides decreased in most of the experiments. The content in water of blood and skeletal muscle decreased in most of the experiments in which it was determined. The results of these experiments are given in Table IV.

Food and water deprivation and removal of whole blood. The duration of the experiments in which whole blood was removed at 12 hour intervals from animals deprived of food and water was 60 hours. The total amount of blood removed from each animal equalled 3 per cent of the body weight. Although the blood pressure was not low at the termination of three of the four experiments, the extremely fast pulse and the general appearance indicated that the animals were very sick. The loss in weight (11.79 per cent) was approximately the same as in the experiments on the œsophagus. The red blood cell count and the hæmoglobin decreased greatly in all experiments. The plasma volume and the blood volume decreased markedly, the decline in the volume of red blood cells being greater than that in the plasma. The decrease in the total blood volume was definitely greater than was found in the experiments in which the œsophagus was divided but the diminution in the plasma volume was slightly less than was found in the œsophagus experiments. The content in chlorides increased in all experiments. The content in water of the blood increased in all instances and that of muscle decreased. The results are given in Table V.

DEDUCTIONS

A comparison of the results which were obtained in the different types of experiments shows that approximately ten per cent of the body weight was lost in all of them. As has been stated previously, the experiments upon food and water deprivation alone were approximately twice the duration of the experiments on the effects of division of the œsophagus. The more rapid loss of weight in the latter experiments was probably due to the loss of saliva. There was an increase in the red blood cell count and the hæmoglobin in practically all of the experiments except those in which whole blood was removed. Likewise, there was a decrease in the content in water of blood and skeletal muscle in most of the experiments except those in which whole blood was removed. In these, the water content of blood increased and that of muscle decreased. The alterations in the content in chlorides were not very great in any of the experiments. In the experiments on the effects of division of the œsophagus and on the effects of removal of plasma associated with food and water deprivation, there was usually a small diminution in the chloride content. In the experiments in which the animals were simply deprived of food and water and in those in which whole blood was removed under similar conditions,

TABLE VI.—THE PERCENTAGE DECREASE IN BLOOD PLASMA AND BLOOD VOLUME AFTER THE VARIOUS PROCEDURES

Type of experiment	Experiment number	Duration of experiment, in hours	Percentage decrease plasma volume	Percentage decrease blood volume	Percentage decrease blood volume due to plasma loss
Division œsophagus	1	50	31.3	21.7	94.9
	2	48	40.7	31.5	75.9
	3	48	34.0	21.2	80.9
	4	48	32.9	17.0	100
	5	24	27.0	24.3	60
	6	43	34.3	31.8	78.1
	7	24	30.7	21.2	69.8
	8	23	19.7	14.3	76.7
	Average		31.3	22.9	79.5
Water and food deprivation	1	80	29.82	18.5	93.6
	2	80	29.9	30.4	51.7
	3	80	8.32	8.34	55.8
	4	80	21.8	21.90	60.0
	Average		22.46	19.78	65.3
Water and food deprivation and plasma removal	1	36	16.50	13.32	64.6
	2	36	36.55	36.70	58.0
	3	48	32.70	19.50	91.6
	4	36	41.65	37.65	70.8
	5	25	24.8	20.9	70.6
	6	25	45.7	44.9	57.0
	7	25	40.5	35.1	67.8
	Average		34.06	29.72	68.63
Water and food deprivation and hæmorrhage	1	60	29.02	36.3	49.4
	2	60	18.41	19.71	56.6
	3	60	19.85	30.30	36.9
	4	60	48.75	47.55	53.4
	Average		29.01	33.47	49.07

there was usually a small increase in the chloride content. The greatest average decrease in the total blood volume was found in the experiments in which whole blood was removed, the next in those experiments in which blood plasma was removed, and next in order were those in which the œsophagus was divided. The average diminution in the plasma volume was slightly greater in the experiments upon plasma removal than in those on œsophagus ligation, while that in the experiments on the effects of removal of whole blood was slightly less. In the experiments on the effects of division of the œsophagus, 80 per cent of the diminution in the total blood volume was due to the loss of plasma, in the experiments on plasma removal, it was 69 per cent, in those on the removal of whole blood it was 49 per cent, and in the experiments on food and water deprivation alone it was 65 per cent. The comparative figures for the different types of experiments are given in Table VI.

The division of the cervical œsophagus and the graded removal of blood plasma from dogs deprived of food and water produced results quite similar in character. Both were associated with approximately the same loss in weight, an increase in the red blood cell count and hæmoglobin, a slight diminution in the content in water of blood and muscle, and approximately the same degree of diminution in the total volume of plasma. The only definite difference was that the reduction in the total blood volume was greater in the experiments on the removal of blood plasma than in those on division of the œsophagus.

These experiments indicate that the cause for the early death after division of the œsophagus is the loss of fluids. The plasma constituted a smaller part of the total blood volume in these experiments than in those in which plasma was removed repeatedly. Wangensteen and Chunn believed that the explanation for the death of dogs with obstruction of the upper part of the intestines was due to the dehydration and loss of chlorides. Haden and Orr(2), in discussing their own results, state: "These results indicate that a fatal intoxication ensues after the cardiac end of the stomach or the œsophagus is obstructed. The clinical course is more rapid and the blood changes are more marked than those occurring subsequent to pyloric or high intestinal obstruction. There is a severe toxæmia as evidenced by the high level of the non-protein nitrogen in the blood. It would seem that the toxic agent must have arisen distal to the obstruction." No further evidence for the action of a toxin is given by them except that sodium chloride which they believe to have a detoxifying action was found to prolong the life of dogs after obstruction of the cardiac end of the stomach.

Three animals in which the cardiac end of the stomach had been obstructed were given subcutaneously 40 cubic centimeters per kilogram body weight of one per cent sodium chloride at varying intervals. They state (3): "The animals survived 32, 36, and 45 days. At autopsy, in each, the tape had cut through, thus reestablishing continuity." Instead of a detoxifying action, it seems more likely that the sodium chloride saved the animals by maintaining the blood volume at a fairly high level until sufficient time had elapsed for the lumen of the cardia to be restored. After this, the secretions from the salivary glands were able to pass into the stomach. The fact that the higher the obstruction is made in the intestinal tract the shorter the length of life is strong evidence in favor of dehydration as being the cause of death. Dogs with obstruction of the pylorus of the stomach live longer than those with obstruction of the cardiac end or of the œsophagus because fluids can reach the stomach under the former condition where they can be at least partially absorbed.

SUMMARY

The blood volume, the plasma volume, the red blood cell count, the hæmoglobin, the content in chlorides of blood, and the content in water of blood and muscle have been determined before and after (1) division of the œsophagus in the neck, (2) food and water deprivation for 80 hours, (3) the graded removal of blood plasma over a period during which the animals were not allowed food and water, and (4) the graded removal of whole blood during a period of food and water deprivation.

The alterations which were produced by ligation of the œsophagus and by the removal of plasma were quite similar. The findings suggest that dehydration which is probably due in the main to the loss of saliva is largely responsible for the early death which follows division of the œsophagus.

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CAUSATION OF BACILLUS WELCHII INFECTIONS IN DOGS BY INJECTION OF STERILE LIVER EXTRACTS OR BILE SALTS[1]

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IN a recent paper Rewbridge reported that the intraperitoneal injection of sterile bile or even sterile bile salts brought about the prompt invasion of the peritoneal cavity of dogs with the Welch bacillus. Andrews also showed that autolysis of sterile liver in the peritoneum of dogs brought about a similar anaerobic infection, that, furthermore, there were thermostable water soluble substances in dogs' livers which were capable themselves of producing the same phenomenon when injected intraperitoneally.

Dragstedt (5) had previously called attention to the rich anaerobic flora of the liver and presented a review of the literature on this subject to which the reader is referred. In his experiments on liver autolysis *in vivo* he found that autoclaved sterile liver underwent sterile slow autolysis in the dog's peritoneum without producing toxic symptoms. However, he used large hard masses of cooked liver which naturally presented little surface for autolysis, and we found that when the livers were ground with sand they would still produce the toxic syndrome even though sterile, and the name "autolysis peritonitis" was given to the condition (1).

In view of these findings the following experiments were undertaken to attempt to show the source of these infections and their mechanism.

EXPERIMENTAL

The first question to be solved was whether the organisms came from the known rich flora of the liver or if they made their way out of the bowel or if the phenomenon was simply a recrudescence of bacteria in tissues brought about by the presence of tissue poisons which reduced the bactericidal power of the cells.

To ascertain if the nearness of the liver was an important factor in a series of four dogs a tube was inserted into the gall bladder which was inverted as for a cholecystostomy and a watertight joint made. This tube was led in four dogs into the cul-de-sac and allowed to drain. In two of these dogs we forgot to ligate the common duct, as intended. In all four, however, there was a prompt death from autolytic peritonitis with a rich Welch bacillus growth. This peritonitis was mainly in the pelvis and lower abdomen at a distance from the liver.

Next, a similar experiment was done in two dogs except that the tube was led over the ribs subcutaneously and then into the chest cavity. One dog died of unknown cause 24 hours later having no bile drainage at all, but the other had bile in the pleural cavity and a hæmorrhagic pleurisy with much exudate and a bacillus welchii infection as demonstrated by obvious gas formation in the tissues and confirmed by culture.

The bile of our laboratory dogs has been shown by Rewbridge to be uniformly sterile, but, in view of the close association with the known liver flora as well as the findings of other observers of bacteria in normal bile, these experiments could not be considered conclusive, and therefore they were repeated with material the sterility of which could be more adequately controlled.

Liver extracts were prepared as outlined in a former paper by Andrews. These extracts in the dose given are uniformly capable of producing a fatal autolytic peritonitis if injected into the upper abdomen. The results are given in Table I. It will be seen from these results that proximity of the liver or the intestinal tract is not an important factor. The Welch bacillus infection can occur in the chest or in the muscular tissues just as well, although the culture of the injected material in each case showed it to be sterile.

Similar series of experiments with sterile bile salt solutions gave quite comparable results. Two series were run, one with 2.5 cubic centimeters per kilogram and one with 5 cubic centimeters per kilogram. The former series gave some positive results but the latter were

[1] From the Department of Surgery of the University of Chicago. This work was done in part under a grant from the Douglas Smith Foundation of the University of Chicago.

TABLE I.—EFFECT OF INJECTING AUTOLYZED LIVER EXTRACT

No.	Material injected	Culture of injection	Survival in hrs.	Culture at autopsy	Postmortem
		1. Injection into pelvis			
206	Water extract of 100 gm. of autolyzed liver concentrated to 25 c.cm. volume	Sterile	24 hrs. Sacrificed distemper	Not done	Not done.
222	Same as 206	Sterile	10 hrs.	B. welchii	Autolytic peritonitis.
		2. Injection into chest			
237	Same as 206	Sterile	5 min.		Shock.
216	Same as 206	Sterile	20 hrs.	B. welchii	Lungs congested, some gas, 200 c.cm. serosanguineous fluid.
226	Same as 206	Sterile	72 hrs.	Negative	Normal chest.
		3. Injection into subcutaneous tissue			
200	Same as 206	Sterile	18 hrs.	B. welchii	Gas in tissue, large abscess formation.
231	Same as 206	Sterile	16 hrs.	B. welchii	Gas in tissue, abscess formation.
236	Same as 206	Sterile	18 hrs.	B. welchii	Gas in tissue. No abscess. Gelatinous œdema.

quite uniformly positive. (See Tables II, III, and IV.)

It is clear from the experiments then that the injection of either of these sterile tissue poisons is capable of setting up a bacillus welchii infection locally whether it is injected into the chest, abdomen, or muscular tissues, and that the proximity of the liver or intestinal tract is not a vital factor in the process. The presence of bacillus welchii in normal muscle is not generally conceded, although it has been reported by Reith, and certain other clinical phenomenon to be discussed later have a bearing on the problem. Small free transplants of muscle have been used freely as hæmostatic agents with no bad results. The following experiments cast some light on this matter. It is well known that the implantation of relatively large amounts of muscle into the peritoneal cavity of dogs is, as a rule, harmless and does not lead to any septic process. However, the use of ground muscle has led to very different results.

Table V shows the results of a set of such experiments. It can be seen that ground sterile muscle produces no infection or toxæmia, and undergoes slow autolysis and that it produces no tissue poison capable of bringing about infection. However, ground fresh, (not autoclaved) muscle when implanted in large amounts brings about a typical autolytic peritonitis. One must assume then that this implanted muscle contains small numbers of bacteria which are freed from cells in the process of grinding and are then capable of multiplying very rapidly on the necrotic tissue.

As further evidence on this point the experiments given in Table VI are referred to. Six dogs were given barbital in doses to last 24 hours. One leg of each was then tied off near the pelvis with hay wire wound as tightly as possible with a pliers. This assured us that no bacteria could make their way into the leg from the circulation. The legs, although thus rendered completely separate, were left on the animals to insure against the possibility of infection being introduced into the cut surface. Three animals were kept as controls, and the three others received injections of liver extract shown by culture to be sterile. All the living animals were sacrificed in 24 hours. The control series, of course, were all gangrenous, but although one of them showed gas bacilli on culture, there was no real gas gangrene in any case. The injected series all were enormously swollen and had evident crepitus to palpation. Incision revealed that the muscles and fascia were riddled with gas bubbles and the cultures all showed Welch bacilli. This experiment is considered by the authors to be a crucial one. There is every reason to think that the same number of bacteria were present in each series, but in the injected ones only gas gangrene occurred. One

TABLE II.—INJECTION OF STERILE BILE SALTS SOLUTION INTO PELVIS

No.	Material injected	Culture of injection	Survival in hrs.	Culture at autopsy	Postmortem
209	2.5 c.cm./kilo of 10% bile salts solution	Sterile	12 hrs.	Streptococcus	No fat necrosis, some inflammation. Very little fluid in peritoneum.
193	Same as 209	Sterile	12 hrs.	Negative	Fat necrosis, some inflammation, 100 c.cm. sero-sanguineous exudate.
189	Same as 209	Sterile	18 hrs.	Negative	Fat necrosis, some inflammation, 50 c.cm sero-sanguineous exudate.
192	Same as 209	Sterile	12 hrs.	B. welchii	Fat necrosis, much inflammation, 300 c.cm. sero-sanguineous exudate.
214	5 c.cm./kilo of 10% bile salts solution	Sterile	12 hrs.	B. welchii	No fat necrosis, marked inflammation, 300 c.cm. sero-sanguineous exudate.
205	Same as 214	Sterile	18 hrs.	B. welchii	Fat necrosis, slight inflammation, some exudate.
211	Same as 214	Sterile	18 hrs.	B. welchii	Fat necrosis, slight inflammation, some exudate.
230	Same as 214	Sterile	4 hrs.	B. welchii	Fat necrosis, slight inflammation, some exudate.
223	Same as 214	Sterile	6 hrs.	B. welchii	No fat necrosis, marked inflammation, 100 c.cm. exudate.

TABLE III.—INJECTION OF STERILE BILE SALTS SOLUTION INTO CHEST

No.	Material injected	Culture of injection	Survival in hrs.	Culture at autopsy	Postmortem
191	2.5 c.cm./kilo of 10% bile salts solution	Sterile	12 hrs.	B. welchii	Bilateral congestion of lungs. Little free fluid.
194	Same as 191	Sterile	16 hrs.	B. welchii	Distemper, bilateral congestion, 50 c.cm. bloody fluid in chest.
195	Same as 191	Sterile	6 hrs.	Negative	Lungs collapsed, excessive fluid in chest.
197	Same as 191	Sterile	12 hrs.	Negative	Hæmorrhagic consolidation. Little free fluid.

TABLE IV.—INJECTION OF STERILE BILE SALTS SOLUTION INTO SUBCUTANEOUS TISSUE

No.	Material injected	Culture of injection	Survival in hrs.	Culture at autopsy	Postmortem
201	2.5 c.cm./kilo of 10% bile salts solution	Sterile	24 hrs.		No indication of injection was found.
188	Same as 201	Sterile	18 hrs.	B. welchii	Slight induration, tiny gas bubbles in tissue.
190	Same as 201	Sterile	24 hrs.		No indication of injection was found.
227	5 c.cm./kilo of 10% bile salts solution	Sterile	12 hrs.	B. welchii	Gas in tissue, induration, no abscess.
210	Same as 227	Sterile	8 hrs.	B. welchii	Gas in tissue, induration, no abscess.
228	Same as 227	Sterile	18 hrs.	B. welchii	Gas in tissue, induration, small abscess.
203	Same as 227	Sterile	24 hrs.	B. welchii	Gas in tissue, induration, no abscess.
235	Same as 227	Sterile	24 hrs.	B. welchii	Gas in tissue, induration, no abscess.

feels justified, therefore, in assuming that the liver extract acts by destroying in some manner the normal bactericidal power of the tissues, so that the rapid multiplication of the organisms is favored.

Bacteriological studies were next made of twelve strains of the Welch bacillus, six of which were recovered from peritoneal exudate from autolytic peritonitis in dogs caused by sterile liver extract, and six from that caused by bile draining into the peritoneum. The organisms were first grown on litmus milk media causing stormy fermentation. They were then plated on anaerobic blood agar plates and the grey colonies surrounded by a zone of beta hæmolysis chosen. Smears were made showing large gram positive bacilli with spores. From this pure culture tubes of a

TABLE V.—EFFECT OF IMPLANTING FRESH GROUND AND AUTOCLAVED MUSCLE INTO PERITONEUM

No.	Material implanted	Culture of implant	Survival in hrs.	Culture at autopsy	Postmortem
202	100 gm. fresh ground muscle removed and ground aseptically	Sterile	24 hrs.	B. welchii	Marked injection of viscera. Little sero-sanguineous exudate.
224	Same as 202	B. welchii	20 hrs.	B. welchii	Injected viscera, 500 c.cm. sero-sanguineous exudate.
234	Same as 202	Sterile	8 hrs.	B. welchii	Injected viscera, 500–700 c.cm. sero-sanguineous exudate.
218	100 gm. of fresh ground autoclaved muscle	Sterile	576 hrs.	Sterile	Normal peritoneum.
229	Same as 218	Sterile	576 hrs.	Sterile	Normal peritoneum.
238	Same as 218	Sterile	576 hrs.	Sterile	Normal peritoneum.

TABLE VI.—EFFECT OF COMPLETE LIGATION OF LIMB WITH AND WITHOUT INJECTION OF LIVER EXTRACT

No.	Material injected	Culture of injection	Survival in hrs.	Culture at autopsy	Postmortem
307	Leg wired completely and a water extract of 100 gm. of autolyzed liver concentrated to 25 c.cm. volume injected	Sterile	20 hrs.	B. welchii	Leg immensely swollen, gelatinous œdema, gas in tissue, no gangrene.
292	Same as 307	Sterile	24 hrs.	B. welchii and diplococci	Leg immensely swollen, gelatinous œdema, gas in tissue, signs of gangrene.
306	Same as 307	Sterile	18 hrs.	B. welchii	Leg immensely swollen, gelatinous œdema, gas in tissue, signs of gangrene.
289	Leg wired completely. Control dog		22 hrs.	Negative	Leg slightly swollen, no gas in tissue, gelatinous œdema, signs of gangrene.
313	Same as 289		24 hrs.	Negative	Leg slightly swollen, no gelatinous œdema, no gas in tissue, signs of gangrene.
291	Same as 289		24 hrs.	B. welchii	Leg slightly swollen, no gelatinous œdema, no gas in tissue, signs of gangrene.

series of sugars were inoculated (see Table VII). This included glucose, lactose, raffinose, sucrose, and trehalose. In each case there was fermentation with the production of both acid and gas. In the series of 12 strains this proves beyond a doubt that the organism is the typical Welch bacillus. Tests of the toxicity of Berkfeld filtrates of broth cultures are shown in Table VIII. All the animals died with paralyses as is typical for this organism.

Toxicity tests were made of the peritoneal exudate of dogs dying of autolytic peritonitis. After numerous experiments on mice had been made with negative results after the use of various fractions, a dog was given intravenously the entire centrifuged exudate from another dog which had just died. This totaled 240 cubic centimeters of bloody purulent material. To our utter surprise there was no evidence whatsoever of any toxic effect. This, in spite of the fact that the centrifuged material contained many bacteria still, although the major portion had been thrown down in the centrifuging. The interpretation of these results is difficult but one is lead to the conclusion that most of the toxic matter had already been absorbed into the circulation of the dying dog.

DISCUSSION

The provocation of infection in the animal body by sterile material is not a new matter. The power of sulphur to cause abscesses has long been known. The substances used by us in these experiments are, however, physiological fluids which might conceivably be duplicated under clinical conditions. The real point, of course, is that all tissues have a considerable bacterial flora, and that tissue injury or death may bring about infection of the tissues by bacteria already present. It is likely that the commonest point of entry for bacteria is through the intestinal tract especially

TABLE VII.—PERITONEAL EXUDATES OF DOGS WITH BILE DRAINING INTO THE PERITONEAL CAVITY

No.	Milk	Glucose	Lactose	Raffinose	Sucrose	Trehalose	Smears
204	Stormy fermentation	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
323	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
324	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli
294	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli
320	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
214	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
			Cultures of the dogs' livers				
1	Stormy fermentation	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
2	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
3	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
4	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
5	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.
6	Same	A & G	A & G	A & G	A & G	A & G	Gram + bacilli.

A—Acid.
G—Gas.

in its upper part. The experiments of Arnold in this matter are quite conclusive and they serve to emphasize the enormous number of bacteria which enter the body daily. He found that in most conditions of digestion the duodenal mucosa was impermeable to bacteria, but that if the chyme had a hydrogen ion concentration of 8.0 (a quite physiological point) and contained protein (egg white) bacteria injected into duodenum were recovered in the thoracic duct in numbers of 500 to 1,000 per cubic centimeter. These bacteria are, of course, taken up mostly in the reticulo-endothelial system and destroyed and this is probably the reason that the flora of the liver is so especially rich. Anaerobes and especially spore formers probably survive longer than other types and are therefore more commonly found in the tissues. It has also been shown by Mueller that the liver is a very important agent in the elimination from the blood stream. There is, of course, the obvious factor that the blood goes through the liver from the intestines although the lymph from them goes directly into the blood stream.

Many other examples can be cited illustrating what might be called "endogenous infection" such as seemed to occur in our animals with ligated legs. The fact that gas gangrene occurs not necessarily from deep wounds but in those with lacerated and contused tissues, of course, is an every day matter for observation. Linton recently and also Eckhoff have reported cases in which gas

TABLE VIII.—THE TOXICITY OF BERKFELD FILTRATES OF 18 HOUR BROTH CULTURES OF BACILLUS WELCHII ADMINISTERED INTRAVENOUSLY TO RABBITS.

Rabbit No.	Amount of filtrate	Result
No. 1.....	5 c.cm.	Death within 20 hours
No. 2.....	10 c.cm.	Death within 45 hours
No. 3.....	15 c.cm.	Death within 96 hours
No. 4.....	20 c.cm.	Death within 18 hours

All animals showed paralysis previous to death.

TABLE VIIIA.—THE TOXICITY OF BERKFELD FILTRATES OF 18 HOUR BROTH CULTURES OF BACILLUS WELCHII ADMINISTERED INTRAPERITONEALLY.

Guinea pig	Amount of filtrate	Result
No. 1.....	10 c.cm.	Death within 15 hours
No. 2.....	5 c.cm.	Death within 48 hours
No. 3.....	1 c.cm.	Living and well
No. 4.....	0.1	Living and well

gangrene occurred without rupture of the skin in gangrenous limbs. Many cases of the same type are in the literature where amputation for gangrene was followed by gas infection. These are of too frequent occurrence to admit of external infection in all cases and must often be due to growth of already present bacteria in the devitalized tissues. This phenomenon is so common that the term "medical gas gangrene" has been coined to apply to the condition.

The prevalence of gas bacillus infection or toxæmia from it has received considerable attention in the clinical literature recently as well as in animal experiments. The Welch bacillus has been blamed for the toxæmia in intestinal obstruction by a considerable number of workers. Appendicitis has yielded such cultures in the hands of many observers. The literature upon these subjects is too large to permit review here but its very magnitude is suggestive of the fact that similar conditions of bacterial growth in normal human tissues take place as well as of those of experimental animals. Davidson recently has even reported observations on the importance of anaerobes in pernicious anæmia. Gordon-Taylor also reports the finding of Welch bacilli in cases of severe, fulminant cholecystitis and gangrenous gall bladders.

These reports of other workers as well as our own experiments serve to call attention to the bacterial content of normal tissues, and especially the richness of the anaerobic flora, and to emphasize the clinical possibility that local gangrene or severe tissue injury may permit an active infection by organism previously lying dormant.

CONCLUSIONS

1. Septic processes may be initiated in the pelvis, chest or muscular tissues by the injection of sterile bile salt solution, bile or sterile liver extract.

2. The infecting agent is the Welch bacillus.

3. This phenomenon is due to organisms already present locally in tissues, which begin to multiply when tissue damage takes place.

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DERANGEMENT OF THE MENISCI OF THE KNEE JOINT

A Report of an End-Result Study of One Hundred and Forty-Two Cases Treated by Operation

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THIS study is limited to mechanical injuries of the menisci, which conditions form the largest part of the group known as internal derangement of the knee joint. One hundred and forty-two such knees were operated upon at the New York Orthopædic Dispensary and Hospital between January, 1920, and August, 1928.

The average time that elapsed from the original injury until the operation was performed was 4½ years. The maximum was 40 years, the minimum 2 weeks. The average time that elapsed from the first visit to the dispensary to the time of operation was 3½ months, the maximum 6 years and the minimum 1 week.

Cases of mechanical injuries of the menisci were more numerous during the latter years of this survey, as follows: 36 cases were operated upon from 1920 to 1924 inclusive, while 108 cases were operated upon from 1925 to August, 1928. These operations were done by fourteen surgeons.

Sixty-four per cent of the patients in this series were males. Injuries to the menisci are more frequent during the active period of life, from 16 to 35 years of age. The average age at the time of operation was 28 years. With the exception of one patient 5 years old who had a congenital abnormality of the meniscus, the ages varied from 11 to 62 years.

KNEE AND MENISCUS INVOLVED

Both knees are equally susceptible to injury and there is practically no difference as to the frequency. The right knee in this series was involved in 72 cases, the left in 70.

One hundred and forty-eight menisci were removed from 142 knees of 139 patients. Three patients had the medial meniscus of both knees removed at different times, 2 patients had the medial and lateral menisci removed at different times, and 4 patients had the medial and lateral menisci removed at the same operation.

The medial meniscus was involved in 129 cases and the lateral in 19, the ratio being one to eight, which is a little higher than in series reported previously by other surgeons. Two-thirds of the lateral meniscus cases were of the right knee.

The onset of symptoms was related in the majority of cases to some kind of injury, which varied in severity. In a few instances the patients could not attribute the onset to a definite trauma and could not give the date of the onset of the symptoms. In this series there were 20 such cases. In two-fifths of the series injury occurred while patient was engaged in some athletic sport.

Classification of injury	Knees
1. Athletics: football, tennis, golf, basket ball, skating, wrestling, hockey, and running	53
2. Fall from height, thrown from a horse or bicycle	31
3. Striking knee on a table, trunk, etc	10
4. Twisting knee while walking or coming to a sudden stop	7
5. Getting up from a kneeling or cross-legged position	3
6. Bending forward to pick up something	3
7. Dancing	4
8. Direct injury by a metal spike	1
9. Injured knee, no other data	5
10. No history of injury	20
11. No records	5
	142

The severity of injury does not seem to have any bearing upon the pathological findings. In several instances where the injury and the symptoms were severe enough to impress the patient we were surprised to find only a loose meniscus, while in other cases where injury and symptoms were slight, the meniscus was found to be split and displaced.

Position of knee at the time of injury. A position of flexion is the most favorable one for injuries to the menisci. In this series 65 cases gave definite history of the knee being in flexion when the injury was sustained,

while in only 2 cases was the injury reported to have occurred with the knee forced into hyperextension. One of these latter was a member of this hospital staff, and at operation the meniscus was found to be loose but not torn. The other case was that of an intelligent young man of 17 years in whose knee the medial meniscus was found completely detached peripherally, rotated 180 degrees, and displaced into the intercondyloid space; there was also a complete rupture of the anterior crucial ligament.

SYMPTOMATOLOGY

1. *Subjective symptoms.*

Pain. Pain was a constant symptom in cases with a definite history of injury. When the reaction from the initial injury had subsided, usually in 2 days to 2 weeks, pain, as well as other symptoms, usually disappeared entirely. The patient might have returned to his normal activity, with no consciousness of the knee ever having been injured, but for a second attack occurring a few days to several weeks later. Except in a few instances, pain, as well as other symptoms, was less in severity in recurrent attacks. Four patients in this series had no pain; two of them complained of stiffness, one of recurrent hydrarthrosis, and one, a child 5 years old, of cracking sounds.

The pain was usually referred to the medial or lateral aspect of the joint, corresponding to the side of the injured meniscus. In exceptional cases pain was referred to the opposite side, to the popliteal space, to the medial, as well as to the lateral, side, or to the entire anterior surface of the knee joint. Two cases gave definite history of pain located at the time of the initial injury over the medial side of the joint. Local tenderness, however, when these patients were examined several weeks later, was localized over the lateral aspect of the joint. Too much emphasis was attached by one of our staff to the localization of pain at the initial injury, the significance of the local tenderness being minimized. In one of these cases the medial meniscus was found to be loose but its removal did not give relief of symptoms. A few months later, after removal of the lateral meniscus, which was found to be split longitudinally, all the symptoms subsided. In the other case the medial meniscus was examined first and removed as being abnormally loose. The surgeon was not satisfied with the pathology, and the lateral side was explored, disclosing a longitudinal split of its meniscus.

One patient with a definite history of pain localized in the popliteal space had both menisci removed at one operation. The medial was abnormally loose, the lateral was split longitudinally. Four patients complaining equally of pain over the medial and lateral aspects of the joint were relieved of their symptoms following removal of the medial meniscus. One patient complaining equally of pain over the medial and lateral sides of the joint had both menisci removed, the medial being loose, the lateral split longitudinally. Three patients complaining of pain over the entire anterior surface of the joint were relieved by removal of the medial meniscus alone.

Swelling. Swelling was next in frequency. It can be stated that with the exception of 14 cases with no definite history of injury, swelling was a constant symptom of which patients complained.

Locking. Locking is the inability to extend the knee fully, actively or passively. It occurs suddenly and is due to the interposition of some substance between the opposed articular surfaces. In the cases of this series it was due to a loose, split, and displaced meniscus. Locking may be momentary or may persist until reduced by manipulation. In a few instances when attempts to unlock the knee joint failed, these patients were operated upon with the knee in the locked position.

In textbooks, locking is considered as the keynote and the most constant symptom in the diagnosis of traumatic lesions of the menisci. In this series it was present in 70 cases, 56 per cent, which is contrary to the general conception of its frequency. In about two-thirds of this number, locking was associated with some of the other sensations, such as slipping, snapping, giving-way, and weakness, while in one-third it was present alone. In recurrences this symptom is

described occasionally as a catching sensation. Locking is here referred to as a subjective symptom because the majority of these patients were seen long after the original injury.

Slipping. Slipping is the sensation of something going out of place in the medial or lateral compartment of the joint, and in this series it was due to the displacement of the meniscus. Slipping is always referred to the side of the injured meniscus and occurs suddenly. The sensation may be associated with other symptoms or occur alone, and in this series it was present in 54 cases, 43 per cent. In a few instances in which the initial injury occurred suddenly, the patient invariably stated that the knee-cap went out of place. In recurrent cases it was described as "snapping."

Weakness. Weakness is the sensation of insecurity and was not complained of at the time of the original injury. It was a symptom usually met with in the free intervals of recurrent cases and also when the displaced meniscus was not completely reduced after the initial attack. Weakness is apparently due to the relaxation of the capsule and the intrinsic ligaments from the recurrent hydrarthrosis, and to the atrophy and loss of tone of the quadriceps muscle. In this series 46 cases, 37 per cent, complained of weakness. Occasionally this symptom is described as instability of the knee joint, a condition which very seldom, if ever, is present unless there is a rupture of the crucial or collateral ligaments associated with the injury of the menisci.

"*Giving-way.*" "Giving-way" is an expression quite often used by the patients to define the feeling of insecurity and of slipping in recurrences. When encountered at the original attack the accident was invariably a minor one, such as getting up from a cross-legged position. It was present in 41 cases, 33 per cent.

2. *Objective findings.*

Swelling. A change in the contour, obliteration of the normal depressions and enlargement of the circumference of the knee joint may be established by inspection, palpation, and measurement. Swelling may be due either to an increase of the joint fluid or to a thickening of the intra-articular tissues, or to both. Swelling usually came on a few hours after the initial injury and was caused by the synovial effusion and extravasated blood. In the intervals between the attacks of recurrent cases, swelling was largely due to the thickening of the intra-articular tissues. In some instances this physical sign was absent, as when the case was seen several weeks after the injury or when the reaction was very slight. In this series 59 per cent showed swelling; of these 13 per cent showed an increase of the joint fluid, 22 per cent intra-articular thickening, and 24 per cent both increase of joint fluid and intra-articular thickening. When the joint fluid is increased, it is evenly distributed throughout the joint cavity, and varies from a dram to several ounces in amount. Thickening of the intra-articular tissues was also evenly distributed, except that in a few cases these changes were more pronounced in the region corresponding to the injury. The degree of intra-articular changes may vary from that of congestion and slight thickening of the synovial membrane or ligament to a general fullness and bulging of the lateral patellar spaces. The changes in the intra-articular tissues depended upon the treatment given immediately after the injury and whether or not the offending meniscus was completely reduced. The duration of the condition, the number of recurrences, and the possible complication of an infectious arthritis are also influencing factors.

Pain on motion and tenderness. Pain on motion and tenderness over the site of the involved meniscus were the most common signs and undoubtedly the most valuable in the diagnosis of traumatic lesions of menisci. The area of tenderness usually was well localized and was situated just below the apex of the patella on the affected side and over the anterior part of the joint line, corresponding to the anterior third of the injured meniscus and the adjacent margin of the tibial tuberosity. The tenderness was undoubtedly due to the inflammatory reaction of the coronary ligament and synovial membrane, and was best detected by examining

the knee in the semi-flexed position. This cardinal sign was present in 117 cases, 85 per cent. About 8 per cent of the cases in this series complained of pain in the popliteal space when the leg was moved to the limits of flexion and extension. A survey of the pathological findings of this particular group failed to explain the reason for pain referred to the popliteal region.

Palpation of injured meniscus. Palpation of a displaced meniscus is a rare finding, although a thickened synovial membrane or an enlarged infrapatellar fat pad may be mistaken for one. The textbooks state that this sign is present approximately in 25 per cent of cases. In this series, however, it was found in only 16 per cent, and this figure may be exaggerated. The pathological findings in those cases in which clinical palpation of the meniscus was recorded revealed an abnormally loose meniscus and not a torn one.

Slight limitation of extension. Slight limitation of extension is defined as a resistance obtained at the end of passive extension of the joint, a sensation suggesting the intervention of an elastic substance between the femoral and tibial articular surfaces. This may be caused either by a slight inward displacement of an abnormally loose but not torn meniscus or by the displacement of a portion of a torn meniscus. An attempt to establish this sign has been made during the past 2 years only and it was found present in 14 cases, 10 of which had a torn meniscus and 4 an abnormally loose one.

Atrophy. In the recurrent type and in those cases in which the displaced meniscus interfered with normal joint function, atrophy of the lower thigh was present. The vastus medialis was the muscle which suffered most. Sixty per cent of the series showed atrophy of the thigh varying from ⅛ inch to 2¼ inches.

Limitation of motion. An abnormally loose or incompletely reduced, torn meniscus may interfere with normal flexion, extension, or with both. Sixty cases, 43 per cent, of the series had limitation of motion varying from 5 to 50 degrees.

Crepitation. Crepitation is usually present in recurrent cases and is attributed to a thickening of the synovial membrane and arthritic proliferation at the articular margins of the patella and femoral condyles. It may be coarse and grating or be felt as a fine leathery friction. It was present in 37 per cent of the series. Its presence signifies a considerable degree of intra-articular change, but is of no diagnostic value as far as injury of the meniscus is concerned.

RADIOGRAPHIC FINDINGS

Radiographic examination of knees for traumatic lesions of menisci is of very little positive diagnostic value, chiefly because the cartilaginous disc does not throw a shadow. The radiograph is valuable, however, in excluding other conditions such as loose bodies, fracture of the tibial spine or tuberosities, osteochondritis dissecans, calcified infrapatellar fat pad, etc., conditions which might simulate the symptoms of a deranged meniscus. In a limited number of cases, and especially in those in which peripheral detachment or longitudinal split and displacement of the meniscus had occurred, the radiograph was of direct diagnostic value by showing an unbalanced joint space, that is, thin on one side and wide on the other. This finding was regarded as evidence of a derangement of the meniscus on the thin side. In a very few cases there was definite projection of the capsular shadow at the joint margin on the affected side in an anteroposterior view. This is not positive evidence of derangement of a meniscus, as the same projection is sometimes noted in other conditions. Preliminary oxygen injection in the knee joint as advocated by some did not result in any definite diagnostic finding in the few cases in which it was tried.

DIAGNOSIS

Let it be stated here that a positive diagnosis is often impossible and that one is never absolutely sure until the joint has been opened and the actual pathology seen. A definite procedure, however, should be followed in making a diagnosis of an injured meniscus. An intelligent history of the accident, including a thorough description of the direction in which the force was applied or the blow received, the position of the knee, the immediate

signs and symptoms and the behavior of the knee afterward, may give the best clues for the diagnosis. In the chronic cases a detailed history is of more diagnostic importance than the physical signs, which in some cases are entirely lacking at the time the examination is made.

TREATMENT

Because of the impossibility of knowing the exact pathological condition immediately following any trauma to the knee joint, nonoperative treatment was adopted for the acute cases except when there was irreducible locking.

Chronic cases seen during the interval of attacks, when the physical examination was practically negative and the history was inconclusive, were referred to the gymnasium for exercises and massage. These patients, however, were kept under close observation for the development of symptoms. The application of apparatus for traumatic lesions of menisci is unnecessary and unwise. Unreduced cartilages, as well as recurrent cases, call for an early operation. Many cases are neglected, thereby injuring the internal structures of the knee joint by a prolonged treatment of braces or plaster casts.

Surgery of the knee joint for the relief of mechanical injuries is making slow progress, which in some measure can be attributed to the so called good results secured by conservatism and also to the fear of sepsis and subsequent stiffness. Regarding conservative treatment in this type of case, let it be stated that histologists, pathologists, and research workers have repeatedly failed to demonstrate any regenerative power of the cartilage. In this series, careful macroscopic and microscopic examinations of the torn menisci showed no evidence of repair. In some instances, however, union had occurred by weak scar tissue. Fear of sepsis and stiffness is no doubt founded upon a lack of surgical knowledge and should not be considered during this period of aseptic surgery. In experienced hands this type of surgery is safe and does not require special pre-operative preparation. A tourniquet is used in every case. It is removed after the knee has been firmly bandaged with cotton flannel.

Incision. Previous to 1923 the transverse, V-shaped, oblique and split patella incisions were used, but they have been discarded as unsatisfactory. The longitudinal incision, which gives a sufficient exposure of the meniscus and also permits a satisfactory view of the joint space, has been the routine since 1923. Whenever exploration of both compartments of the joint is called for, the bilateral exposure through longitudinal incisions is preferred.

Removal of an innocent looking meniscus, when no other abnormality is found to explain the clinical signs and symptoms, is advisable. Many cases are recalled in which the supposed offending meniscus upon inspection appeared to be normal, yet upon removal a tear at the posterior half or an extensive injury of its tibial surface was found.

Total excision of the meniscus is impossible by any of the incisions mentioned. Approximately the anterior three-fourths of the meniscus is removed. This is considered satisfactory as the remaining one-fourth has not proved in this series to be a potent cause of recurrent symptoms.

Postoperative mobilization. Passive mobilization is started on the first day after operation and is accomplished with very little discomfort, while it lessens the swelling and considerably shortens the convalescent period. Weight-bearing is allowed on the sixth day after operation, and the patient is discharged from the hospital in 9 to 12 days after operation. Postoperative splinting of the knee has been discarded since 1921.

Surgical pathology of menisci. It is impossible to predict the type of the injury of the meniscus, even in those cases in which an intelligent history of the accident is obtained. It has been noted that nothing more than a relaxed meniscus may be found at operation in a case with a history of a severe injury followed by a marked reaction, while a meniscus longitudinally split and displaced may be associated with a minor injury and with a slight reaction. The same uncertainty is true as to recurrences. Patients with a severely damaged meniscus may go without any symptoms for several weeks or even months, while others with only a relaxed meniscus may be subject to frequent attacks.

Pathological findings of menisci were as follows:

	Menisci
Hypermobile	54
Longitudinally split	29
Anterior end detached	23
Transverse or oblique tear	14
Partially detached peripherally	12
Torn at the posterior horn	7
Ragged, fibrillated	8
Cystic degeneration	1
	148

It is evident that an untorn, hypermobile meniscus is a definite entity and that relief of symptoms may be obtained by its removal. In this series, this condition was present in 54 cases, 36 per cent.

Other operative findings. Thickening of the synovial membrane was present in 65 cases, 45 per cent. Arthritic lipping was found in 24 cases, 17 per cent. Of these, 14 cases were in patients under 30 years of age, and it was believed that these changes were incited by the mechanical irritation from the damaged meniscus. Enlargement or fibrosis of the infrapatellar fat pad was present in 57 cases, 39 per cent. It is not probable that this latter condition can simulate the clinical signs and symptoms of a damaged meniscus.

Other superimposed pathological conditions were as follows:

	Cases
Loose bodies (non-ossified) composed of fibrin, synovial tissue, or cartilage	11
Loose bodies ossified	3
Torn crucial ligament	5
Subluxation of patella	4
Fibrillation of articular surface of patella	4
Osteochondritis dissecans	2
Cystic degeneration of lateral meniscus	1
Fracture of medial tibial tuberosity	2

Procedure. Every case operated upon in this series had a meniscus excised. The conditions mentioned in the preceding table may simulate the symptoms of an injured meniscus but they are included in this series because the pre-operative symptoms strongly suggested that the meniscus was involved also. Excision of the meniscus may be defined as its removal as far posteriorly as possible, including at least the anterior three-fourths. Excision of the entire meniscus, removal or repair of the torn fragment, or repair of the relaxed coronary ligament was not done.

The surgical procedure was as follows:

	Menisci
Excision of meniscus, without any other surgical procedure	83
Excision of meniscus and fibrotic tabs of the infrapatellar fat pad	41
Excision of meniscus, fibrotic tabs of the infrapatellar fat pad, and removal of loose bodies	8
Excision of meniscus and removal of loose bodies	6
Excision of meniscus and shaving of the fibrillated articular surface of patella	4
Excision of meniscus and plication of capsule for subluxating patella	3
Excision of meniscus and transplantation of tibial tubercle for dislocating patella	1
Excision of meniscus and repair of anterior crucial ligament	1
Excision of meniscus and partial synovectomy	1
	148

Hæmarthrosis. Extravasation of blood in varying degree occurs in every case after operation. Its presence is demonstrated on the day the sutures are removed unless an earlier inspection has been made in order to explain an abnormal temperature. In this series only 17 cases were recorded as having had considerable hæmarthrosis, while in the remainder swelling was recorded as slight or of moderate degree. It is believed that the use of a firm cotton flannel bandage has considerably lessened the frequency and the amount of hæmarthrosis and that early mobilization hastens its absorption. Aspiration or probing is unnecessary.

Postoperative infection. There was no postoperative infection in the knee-joint. There were 9 cases of superficial infection, including 3 cases with stitch abscesses, all of which healed, with free and painless motion, in 15 to 20 days.

Postoperative physiotherapy. Light massage, which was started immediately following the removal of sutures and while the patient was still in the hospital, was continued in the physical therapy department from 2 to 6 weeks. With the massage, passive and active exercises were also given.

Postoperative convalescence. The average period of time until the patient returned to his former occupation was 38 days; maximum, 3 months; minimum, 7 days.

Postoperative hypermobility. The statement is frequently made in the literature that hypermobility or instability is not unusual

following removal of a meniscus, but in this series no patient complained of this. However, in 4 cases not including those with rupture of the crucial ligaments, hypermobility was present after the operation, but in the same cases it had been found before operation. The 6 cases in which both menisci were removed showed no hypermobility.

END-RESULTS

Of the entire series 8 cases have not been seen since their discharge from the hospital following operation. Because of the fact that there was no individual who was not improved by the operation, the results of the remaining 134 cases are classified in two groups, excellent and good.

In the first group there were 114 cases, 85 per cent, which included: (1) Twenty-two patients who although upon casual inquiry considered the result as excellent and at the end-result examination failed to present any objective findings, yet upon a closer questioning admitted the existence of subjective symptoms such as fatigue after long standing or walking, inability to kneel, stiffness on rainy days, etc. All these patients have returned to their regular occupations, participate in athletics, etc. (2) Seven patients who were unable to report for end-result examination wrote that they were very much pleased with the operation and considered the result excellent. (3) Twenty patients who could not be traced for the end-result examination but who were discharged from the follow-up clinic with an excellent result 2 to 4 years after operation.

In the second group there were 20 cases, 15 per cent. These patients were relieved of the major part of their symptoms but at the end-result examination presented a few symptoms or objective findings or both. In this group are included 8 patients who could not be traced for the end-result examination, but when last seen were partially relieved.

It is interesting to note that no patient in the last group presented a typical history of deranged meniscus. They were patients who were operated upon either to establish the pathological condition, after a long period of observation at the clinic, or patients with superimposed pathology, such as fracture of the tibial tuberosity, chronic arthritis with fibrillation of the articular cartilage, osteochondritis dissecans, etc.

SUMMARY

1. One hundred and forty-four operations on 139 patients with derangements of a meniscus are reported.

2. The operations were all done between January, 1920, and August, 1928.

3. There were 89 males and 50 females.

4. The age at the time of operation varied between 11 and 62 years, the average being 28 years.

5. There was no operative death or cases of postoperative infection of the knee joint.

6. The average duration of symptoms before operation was 4½ years.

7. The results were 85 per cent excellent and 15 per cent good.

CONCLUSIONS

1. An untorn, hypermobile meniscus is a definite entity.

2. A deranged meniscus may occur in an arthritic joint or may be the inciting cause of arthritis on account of the constant mechanical irritation.

3. The presence of arthritis in a knee joint, complicated by a deranged meniscus, does not constitute a contra-indication for operation, and the symptoms may be greatly relieved by removal of the meniscus.

4. Removal of one or both menisci does not result in an unstable knee joint.

5. The removal of an offending meniscus by operation is a better procedure than any prolonged conservative method of treatment.

6. The relief of symptoms in uncomplicated traumatic lesions of menisci is uniformly complete following removal of the meniscus.

PRIMARY SYNOVIAL MEMBRANE TUMORS OF JOINTS

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PRIMARY synovial membrane tumors of joints are relatively rare neoplasms. Although a case was reported as long ago as 1865 by Langenbeck, Hartman, in 1922, in an excellent review of the literature, could find only 16 cases, to which he added one of his own.

In Hartman's article there were 4 case reports of pedunculated tumors. All of these occurred in the knee joint, they were all diagnosed as sarcoma, and 3 of them recovered, with no note as to the fate of the fourth. Two of these tumors showed giant cells.

The other cases he classified as diffuse tumors with giant cells and diffuse tumors without giant cells. There were 4 of the former and 9 of the latter. In those with giant cells, 3 of the patients recovered. In the fourth, recurrence of the growth after local excision necessitated thigh amputation, and the gross specimen showed not only local recurrence but several plaques of grayish tissue in the bones about the knee, which may be considered as evidence of metastasis. Three of these tumors were in the knee with the other in the ankle joint.

The diffuse tumors without giant cells are evidently of potentially higher malignancy than either of the other groups. One of these died from metastases and another showed rapid early metastatic growths, although no record of the final result is given. Eight were diagnosed sarcoma while in the ninth no histopathological diagnosis was made. All of these occurred in the knee joint except one which was found in the ankle.

Since Hartman's article there has been the same paucity of literature on true joint tumors. In 1921, Osgood reported a cavernous angioma of the knee joint on which he had operated and included 3 other similar cases described by Zesas, Reichel and Oesser, but these were not true synovial membrane tumors.

In 1927, Harbitz of Oslo reported very briefly 10 cases of tumors of the articular capsule and synovial membrane and in more detail described two diffuse infiltrating tumors of the synovial membrane of the knee. Although he was not specific as to this point, we take it that all these specimens were studied at the University of Oslo. Of the first 10 cases, it would seem that only 2 are definitely proved primary synovial membrane tumors. Both of these occurred in the knee joint and both were diagnosed sarcoma. One was pedunculated. The 8 other cases which Harbitz briefly reported occurred in the capsule, but apparently were not primary in the synovial membrane. The two diffuse infiltrating tumors he described were primary in the synovial membrane of the knee and had invaded both cartilage and bone. One of these patients died following amputation, while the other had a resection of the joint which evidently was curative. The fatal tumor was a polymorphonuclear cell sarcoma with giant cells, and the less malignant, though infiltrative growth, he classified as a xanthofibrosarcoma.

In a group of four tumors which he called synoviomata and which he considered to be different from any form of neoplasm hitherto described Smith included one which was primary in the synovial membrane of the knee. It was a rapidly growing malignant neoplasm and death occurred five months after amputation through the thigh.

TALBOT'S CASES

Talbot, in 1928, added 3 cases to those already reported, but limited his article to those primary synovial membrane tumors containing giant cells. He gave a very complete report of 1 case of his own and almost as full an account of 2 other recent cases in the French literature, in addition to giving abstracts of 6 other cases which were quoted in Hartman's article. The bibliography which follows his paper is admirably comprehensive.

Talbot's patient was a man, 20 years old, who was admitted to the hospital because of swelling and a slight disturbance of function in the ankle. This had followed a fracture of the thigh 4 years before which

had been treated by traction on the ankle for 60 days. On examination, the left ankle was found to be swollen. There was a protruding mass in front of the ankle on either side, which partially disappeared on plantar flexion and increased on dorsiflexion of the foot. These swellings were flabby and pseudo-fluctuant, but the lateral mass was smooth, firm, movable, somewhat like a loose body in the joint. No pedicle was felt. The general physical examination revealed nothing abnormal and an X-ray of the ankle was negative. At operation a tumor was found in the ankle joint attached by a pedicle to the deep surface of the articular synovia. It was excised with the synovia at the base of the pedicle and the joint was closed in layers. He noted especially that there was no connection between the tumor and the adjacent tendon sheaths. The tumor measured 5 centimeters long by 3 centimeters wide by 2 centimeters in thickness. It was lobulated and pedunculated. The color varied from yellowish saffron to ochre, and the consistency was hard at the level of the pedicle, but soft toward the free pole. Microscopic examination showed large numbers of giant cells, surrounded by fusiform cells, areas of pigmentation, as from old hæmorrhages, large cells containing pigment, and polyhedral cells with a central nucleus and vacuolar cytoplasm. These last cells resembled the fat cells found about synovial membranes. The whole tumor was surrounded by a layer of fibrous tissue, covered over by serous endothelium. There was no cellular evidence of malignancy. The diagnosis was a giant cell tumor primary in the synovial membrane of the ankle (myeloplaxoma).

Talbot quoted fully also a case reported by Abadie d'Oran in 1928.

A woman, 45 years old, for several months had had a small flat painless tumor on the outer side of the right knee a little behind the patella and in front of the external lateral ligament. At operation it was found attached to the synovial membrane and in order to remove it a square centimeter of synovia had to be excised with it. The microscopic examination showed it to be composed of diverse types of cells, with typical lymphocytes predominating, but there were also plasma cells, macrophages, and giant cells. No lipoidal cells as such were mentioned, but large lymphocytes with a clear nucleus were present.

A third case in Talbot's review is that reported by Paitre and Bruas in 1923.

A soldier, who had had a slight fall on the left knee a year before, had noticed a "little swelling" develop in the knee. Only for a few days previous to their examination had he complained of a slight discomfort and abnormal fatigue. When examined, the knee was slightly swollen. In the lower part of the joint there was noticed a little protuberance which bulged out the length of the external border of the patellar ligament. This swelling was increased on flexion of the knee and it was fixed by contraction of the quadriceps. On palpation a mass the size of an apricot seed, hard as cartilage, could be felt under the patella ligament and apparently attached to it. This mass could be moved laterally with the ligament, but not vertically. It was not attached to the bone. Another small mass, the size of a pea, could be felt near the tibial insertion of the ligament, but not seeming to be a part of it. There was fine crepitation on motion of the knee, with flexion limited to a right angle by pain. The physical examination was otherwise negative, as was radiographic examination of the knee. At operation the joint was opened through an external parapatellar incision. A tumor as large as a small tangerine was found implanted in the fat pad in the intercondylar notch. It was pedunculated. When this was excised six or seven little verrucosities, the size of small peas, were found in the depths of the intercondylar notch, in the niche resulting from the enucleation of the tumor. These suggested an arborescent lipoma, but the consistency was that of a fibroma. The joint was closed and the patient was discharged in 3 weeks. The histological examination showed it to be a tumor which was not homogeneous or encapsulated, composed of much dense fibrous tissue with many fibroblasts but with no cells showing abnormal mitosis. Giant cells were found in small numbers and only in certain portions of the growth. The diagnosis was fibrosarcoma, with giant cells—histologically, a benign tumor.

WAGNER'S CASES

In 1930, L. C. Wagner added 2 cases from the files of the late Dr. Virgil P. Gibney and himself. He states that these are the only 2 tumors of this type found in a study of 467 explorations of the major joints of the body, extending from the year 1900 to 1930. He calls both of his neoplasms intra-articular endothelial tumors and in the discussion of his cases Ewing says: "I should think that the diagnosis of fibro-endothelioma was correct. . . . I would not venture to make a diagnosis on the lantern slides alone, if I had not seen in the past 3 months 3 cases very similar to these; 1 from Dr. Bloodgood, 1 from Dr. Smith of Harvard, and another of our own. . . . The position of the tumor is strongly suggestive of an origin from the endothelial cells lining the bursa. There is no doubt that the bursal endothelioma is capable of extensive proliferation producing tumors of this same general character."

In his first case, a man 35 years old without any apparent cause began to complain about 10 years before he saw him of pain in the right knee. Examination showed him to be in good condition but

he was walking with a slight limp, although the functions of the right knee were not impaired. There was a 1 inch difference in the measurement of the knees, with a slight fullness under the right patellar tendon, which was slightly tender. He was treated for 4 months for chronic synovitis, but as there was no improvement the patella was split and the knee joint explored. Previous to this an X-ray film was taken which showed a mass behind the patellar tendon. A solid tumor covered by a synovial veil lay in the knee joint. It was attached to the outer antero-inferior border of the capsule by a small attachment. It measured 7 centimeters by 5 centimeters by 3 centimeters, and was surrounded by a definite capsule. Under the microscope the tumor showed peculiar, elongated, blunt cells sometimes fusiform in shape, lying closely together. The nuclei were round and oval in shape. In certain zones the fibrous tissue seemed to exceed the cellular elements. Numerous mitotic figures were noted, and one would think one was dealing with an atypical sarcomatous growth. As to color, the tumor had a yellow and brownish tinge, resembling the color of synovial membrane; it was resistant as in kidney tissue, therefore very cellular. On cut surface the increased pigment was shown near the center in small islets.

After 1 year there was a recurrence of the growth on the outer side of the knee, treated by an extensive capsular resection. A year later, in spite of treatment with X-rays and Coley's toxin, there was another recurrence which invaded the upper end of the tibia and a mid-thigh amputation was done. He has now been well for 4 years.

Wagner's second case was a girl, 15 years old, who had complained of pain and swelling on the front of the right ankle for 6 years. Examination was negative except for a semi-solid, movable tumor on the front of the right ankle under the tendons on the dorsum of the ankle. X-rays showed a definite soft tissue mass anterior to the ankle joint. An arthrotomy exposed a tumor 6 centimeters by 3 centimeters by 2 centimeters attached to the synovial membrane of the ankle joint. It was similar grossly and microscopically to the other tumor he describes, except that it showed no mitotic figures. The girl has remained well for 1 year, although when last seen she complained of a little pain which Wagner says usually precedes the appearance of the tumor. Therefore he suspects a recurrence.

AUTHOR'S CASES

The writer's interest in this subject has been stimulated by a recent case in a young woman operated upon by him and his associate, Dr. William Tate Graham. This is the second case of primary synovial membrane tumor we have operated upon in the past 6 years, during which period the number of cases available for examination has been large. Both cases are reported here in detail.

CASE 1. Miss E. C. B., aged 49 years, was seen May 10, 1924, complaining of a "growth in the left knee." She was worried about it, because her mother had died of cancer of the breast and she herself had undergone a radical operation for carcinoma of the right breast in 1914. There had been no recurrence. For several years she had noticed a tendency of the left knee to lock and at times this threw her rather severely. For the past 2 or 3 years she had been able to palpate a small, freely movable, soft mass just above the knee cap, located rather deep. She had slight pains at times, and recently had had two or three bad falls, when the knee gave away under her.

The general examination was negative, except that the right breast had been removed by the radical operation and there was a small scar over the inner lower quadrant of the left breast. The left knee showed a small, firm, somewhat movable mass about the size of a pea located just above and to the outer side of the patella, apparently beneath the quadriceps tendon. It was not tender. There was no effusion in the joint and joint motion was free. The skin over the mass appeared normal. There was no atrophy of the extremity and no adenopathy. The X-ray examination was negative. A diagnosis of joint mouse, or loose body in the knee joint, was made and the patient was operated upon May 15, 1924 (Drs. Graham and Faulkner). A 5 inch vertical incision was made over the lateral surface of the left knee joint, just external to the patella. When the joint was opened and the knee was flexed, a dull yellowish tumor, about 4 by 6 by 2 centimeters, which was fairly vascular, came into view. It was attached by a short pedicle to the synovial membrane about 1 inch below its anterior attachment to the external condyle of the femur. The pedicle was clamped and cut and the tumor excised. There was some oozing from the stump of the pedicle, easily controlled by a ligature. The joint was closed in layers and a pillow splint applied.

The pathological report (Dr. S. W. Budd) was: "The section is composed of fibrous tissue, a large amount of blood pigment, numerous giant cells, and very active cells of mesodermic origin that make the growth assume some of the characteristics of a sarcoma. Yet a careful microscopic study leads one to believe that these cells, while active, are not vegetative or malignant in character. The active mesothelial cells with the giant cells and pigment are collected in lobules, separated by wide strands of fibrous tissue. The whole structure is very vascular. This is particularly noticeable in the fibrous tissue separating the lobules, although blood vessels of considerable size are present in the lobules. In the lobules where the cells take on sarcoid appearance, there are numerous large macrophages filled with pigment. Here and there one sees a typical foam cell.

"The question as to diagnosis of this tissue is intricate. The activity is not enough to warrant the diagnosis of a sarcoma, and, for all purposes, a sarcoid growth more nearly sums up the condition we have just described." (Figs. 1 and 2.)

Following the operation a series of high voltage X-ray treatments were administered by Dr. A. L. Gray. The patient made an uneventful recovery and has remained well for six years.

CASE 2. Miss J. A. M., white female, aged 28 years, was seen May 10, 1930, complaining of severe pain and swelling in the left knee. One year ago, while in New York waiting for an elevated train, she felt something slip to the outer side of her left knee cap. Following this the knee became quite painful and swollen and sometime later was discolored. The pain persisted and on her return home she saw her physician who had the knee X-rayed. The radiograph failed to show anything abnormal. Several times since this she has felt something slip in her knee and pain and swelling has followed. On one occasion, her mother felt something like "cartilage in the hollow just below the knee cap on the outside." She pushed this back and it disappeared. Sometimes the knee would become momentarily locked in flexion, but after a minute or two something would slip back into place in it and she could straighten it. She thought she might have injured the knee twice by slight falls, but she could not remember any relationship between these and the slipping in the joint.

The past history was unimportant. She had influenza in 1918, an appendectomy in 1925, and an incision of an abscess in the neck during infancy.

Physical examination showed a well developed and well nourished young woman with no significant finding except in the left knee. The knee joint was distended by effusion. There was tenderness especially marked along the joint line anteriorly. To the inner side of the lower medial angle of the patella was felt a smooth, ovoid, fairly firm body apparently within the joint, which moved under the palpating finger. This movement caused acute pain. The movable body seemed about 2 centimeters in diameter. No other mass was felt. There was motion in the joint from 170 to 120 degrees. No inguinal adenopathy was noted. The Wassermann was negative, and blood and urine findings were normal.

A roentgen-ray examination by Dr. J. L. Tabb showed no bone lesion, no evidence of a joint mouse, and the joint space appeared normal.

A provisional diagnosis of loose body in the knee joint was made and a patella-splitting arthrotomy was done May 19, 1930 (Drs. Graham and Faulkner). On opening the knee, several ounces of serosanguineous, mucinous fluid escaped, together with several gelatinous clots. The synovia was injected. Attached to the anterior synovia by a pedicle about 1 inch above the internal tuberosity of the tibia was a three-lobed tumor 3½ by 1½ by ½ inches in size, which resembled in shape and in color an oyster too long out of water. This was movable on its pedicle and lay in the anterior compartment of the joint between the femur and the tibia. No loose bodies or other tumor masses were found. The cartilages and the ligaments were normal in appearance. The tumor was removed by dividing its pedicle flush with the synovia, but not excising the synovial membrane base. The incision was closed in the usual manner.

The pathologist, Dr. Charles Phillips, reported on the tumor as follows: "The gross specimen is a smooth, somewhat lobulated, gray, red and yellow, moderately firm, irregular ovoid mass, 6½ by 3 by 1 centimeter. It is bent upon itself with its edges partly adherent to form a structure somewhat resembling the finger of a glove. The mass was attached by a pedicle to the synovial membrane.

"Microscopically, it is a connective tissue neoplasm bearing a superficial resemblance to granulation tissue. Much of its substance is necrotic, probably due to constriction of the pedicle with consequent nutritional interference. The cell type is inconstant; fibroblasts, foamy polyhedral cells of the xanthoma type, and a few giant cells are seen. There is much phagocytized blood pigment which reacts positively for iron. The histological structure does not suggest a high degree of malignancy.

"Pathological diagnosis: Mixed cell sarcoma of synovial membrane." (Figs. 3, 4, and 5.)

The patient had an uneventful convalescence and was walking at the end of the fourth postoperative week. Eight weeks after operation there were more than 90 degrees' motion in the knee, no fluid or pain, but some tenderness and thickening just to the outer side of the latero-inferior angle of the patella. She was referred to Dr. Tabb for postoperative roentgen-ray therapy. At the present time (4 months after operation), there are 120 degrees' motion in the knee, occasional slight pain, but no evidence of recurrence, and she walks and swims as she wishes.

CLASSIFICATION

Hartman classified primary synovial membrane tumors under three heads: (1) pedunculated tumors, (2) diffuse tumors with giant cells, (3) diffuse tumors without giant cells. This is a good working classification, but it seems to us a simpler and just as serviceable a division would be into those with and those without giant cells. Certainly, those with giant cells, the myeloplaxoma of the French, as a rule give a characteristic microscopic picture, while the tumors without giant cells are of diverse types.

ETIOLOGY

As with most neoplasms, the etiology can only be guessed at. The predilection of primary synovial membrane tumors for the knee is remarkable. Of the 29 cases reported, including both of the author's, 25 were found in the knee joint. Is this because the knee is more frequently explored than any other

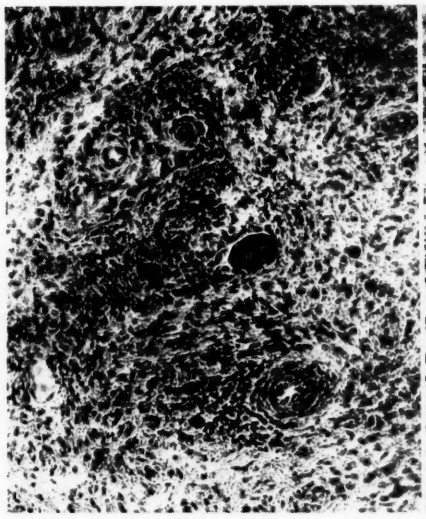

Fig. 1. Case 1.

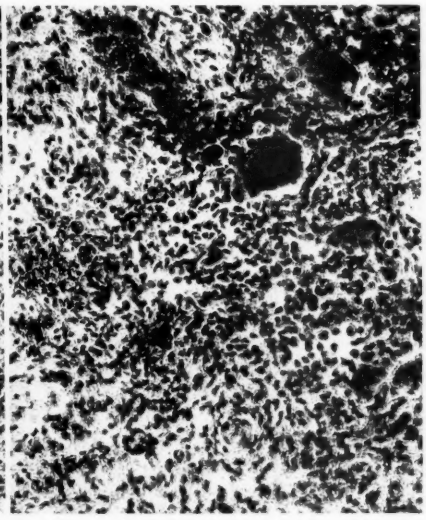

Fig. 2. Case 1.

joint or is it because it is subjected to constant stress and strain and its synovia liable to slight, but continuous, irritation or even injury?

In those tumors with giant cells, it may be surmised that there is an irritative factor. The presence of dense fibrous tissue, of cells containing phagocytized blood pigment, and of giant cells somewhat of the foreign body type may be taken as some evidence that the origin of the tumor was from chronic irritation and inflammatory reaction. But this is not true of the other types and of course all these elements may be found in true neoplasms.

Perhaps some of the tumors are not true neoplasms, but an inflammatory reaction of the synovial membrane. On the other hand, 3 of the cases reported resulted in death from metastases, and there are records of 5 patients with local recurrence or metastasis.

PATHOLOGY

In a microscopic study of these tumors there is one group which presents a very constant and characteristic picture. This is the tumor which Talbot and other French observers call "tumeur a myeloplaxes" or myeloplaxoma of the synovial membrane. Ten such tumors are found in this series of cases. Talbot's description of them is very accurate and may be summarized here. The structure is polymorphous, but the elements which make up the tumor are the same in every case. Essentially, these tumors are made up of dense, inflammatory connective tissue in the midst of which are three typical findings: first, the giant cells which are somewhere between the giant cell of bone and that of the tubercle; second, the lipoidal or xanthoma cell; and third, the blood pigment found in and about the macrophagocytes. There are no atypical mitotic figures and no embryonic cells. There is no histological evidence of malignancy in these tumors.

Fig. 3. Case 2.

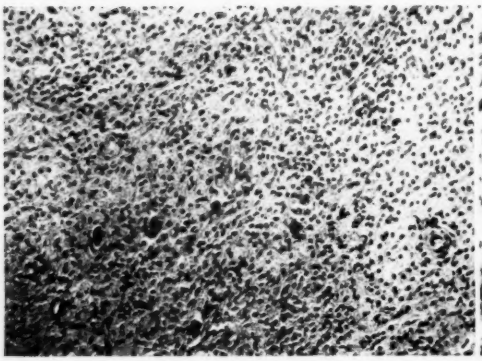

Fig. 4. Case 2.

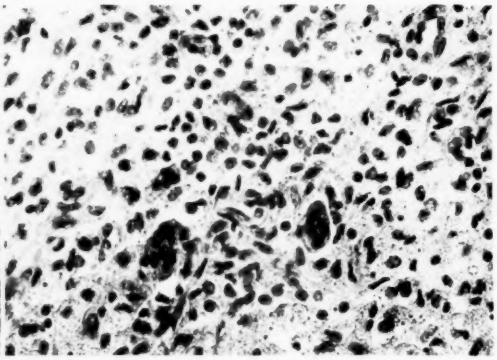

Fig. 5. Case 2.

Both of our tumors are of this type as are all of Talbot's. Although they are usually not malignant, the prognosis must be guarded, as two of Hartman's series had local recurrences, and one of Harbitz's with giant cells died. All 3 were diffuse.

The synovial membrane tumors without giant cells are of rather diverse pathology. Except for the synovioma described by Smith and the endotheliomata reported by Wagner they are all described as sarcoma of different types: spindle celled, round celled, large celled sarcoma, vascular fibrosarcoma, and myeloid sarcoma. The synovioma resulted in an early death, as did one of the sarcomata, while the vascular fibrosarcoma and one of the endotheliomata recurred and invaded the neighboring bone. These tumors without giant cells seem to be potentially more malignant.

DIAGNOSIS

The diagnosis of primary synovial membrane tumor is rarely made before operation. Usually, the pre-operative diagnosis is a loose body in the joint, a tuberculous arthritis, or a villous arthritis. As a rule, a mass can be felt in the joint, but, if pedunculated, it is easily movable and it is thought to be a loose body. The history is never definite. Sometimes, as in one of our patients, there is severe pain, in other cases the pain is negligible, and there is merely a little discomfort and slight disability. There is no special age preference and the cases are about equally distributed as to sex. All of those reported have been in the knee and in the ankle, predominantly in the former joint; but as the knee is a favorite joint for loose bodies and for various forms of arthritis, the site scarcely aids one in making a diagnosis. Probably, X-ray examination of the joint after air injection would be helpful, but the correct diagnosis usually awaits the surgeon's knife.

PROGNOSIS

The prognosis is generally good, both for life and for preservation of the limb. There have been three deaths due to the tumor itself and one other because of operative infection. In this case, an autopsy showed no local or remote metastases. Four thigh amputations were done. Thus in 29 patients with true primary synovial membrane tumors, there has been a mortality of about 14 per cent, a loss of limb in 14 per cent, and cure, as far as is known, in 72 per cent. In the 21 cured cases, 16 retained function of the joint and 5 of the joints were resected. On the whole, this is an excellent record, and seems to show that there is more than a 50 per cent chance of retaining joint function after a relatively early operation for primary synovial membrane tumor. After the microscopic examination has been made, the prognosis is a little more certain. If the tumor contains giant cells, there is approximately a 90 per cent chance for life and a 75 per cent chance for retaining joint function. Yet, the prognosis should always be guarded, first, because a primary synovial membrane tumor with giant cells has been known to cause death or to

recur; and, second, a supposedly primary synovial membrane tumor may be secondary to a hidden osseous tumor, yet show lack of clinical evidence of malignancy.

TREATMENT

Treatment must be directed to (a) preservation of life, (b) saving of limb, and (c) retention of joint function.

In every case, it is wise at operation to have a frozen section examination by a competent pathologist. Due to the scarcity of material, few pathologists are familiar enough with the histology of these tumors to render an exact opinion as to the degree of malignancy of the growth; but in both of our cases the pathologists have strengthened our decision to do a conservative operation by stating that the histological picture did not suggest a high grade of malignancy.

In any synovial membrane tumor there is a possibility of malignancy which may result in death. But this chance is small enough to justify one in conservative surgery, especially so since, if the tumor be highly malignant, amputation offers little hope of cure.

In those cases in which a single pedunculated tumor is found, early excision of the tumor with its pedicle and preferably with resection of the small synovial base of the pedicle will usually result in saving life and limb and in the return of joint function. Certainly here it is wise to be conservative.

In the diffuse tumors, whether or not pedunculated, synovectomy, partial or complete, depending on the extent of the synovial involvement, would seem to be the best treatment. If there is infiltration and partial destruction of the ligaments and cartilage, so that the joint structures seem badly damaged, one would feel inclined to do a joint resection and arthrodesis.

Talbot makes an interesting suggestion in regard to those diffuse tumors with giant cells where it is difficult and mutilating to remove all the growth. Recalling the radiosensitivity of giant cell tumors of bones, he says it would appear justifiable to try radiotherapy before proceeding to an extensive synovectomy or a joint resection, with the consequent loss of joint function. We believe operation should always be followed by a course of radiotherapy, but we feel more secure with surgery as the primary treatment; for, in addition to ridding the patient of the growth, it permits a thorough pathological examination.

If, after the conservative operation, there is recurrence of the tumor with invasion of tissue other than the synovia, high amputation should be performed at once.

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ANATOMICAL FACTORS INFLUENCING MALIGNANCY OF THE SKIN OF THE FACE

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IN almost all of the recent literature on malignancy great stress has been laid upon the histopathological picture, the index of malignancy, and cell type. The writings of Broders, Maltzoff, and Norris, describing the grading of carcinoma on the basis of cellular differentiation, have claimed the radiologists' undivided attention. Broders originally began his work as a classification for surgical prognosis; but the radiologists were not slow to relate the phenomenon of radiosensitivity to embryonal cellular structure and joyfully find an explanation for hitherto inexplicable radiation responses.

We feel that too much emphasis is being laid upon the histopathological grading of carcinoma and that not enough is being laid upon other very important factors. It is our purpose to show the importance of the anatomical factors in carcinoma of the skin of the face; which factors, to our minds, are as important as the histopathological grading in the prognosis.

Throughout the literature we find statements like this: "The grading of these carcinomata is very important from the standpoint of prognosis and treatment" (4). But deep study of the article fails to reveal any difference in treatment accorded, Grade 1 or Grade 4, Broders. Obviously we have been following a fashion. However, I would point to Quimby's latest work (8) in which a real difference is made in the treatment of these two grades of malignancy on a reasonable scientific basis.

A more hopeful sign, however, is found in the work of Lee, who has produced a clinical index of malignancy for carcinoma of the breast. A clinical index of this nature tends to evaluate the various factors entering into the prognosis without undue emphasis upon any one. It is a common observation among radiologists that in women with carcinoma of the cervix, the thin do well; the fat not very well. Any prognosis must properly evaluate all the factors.

After observing malignancies upon the skin of the face for a number of years, it has become quite apparent that in certain locations malignancies are more refractory to treatment, recurrences are more common and have more often pursued a course independent of their cell type than have malignancies affecting other parts of the body.

After considerable study one factor of great importance in carcinoma of the skin of the face has seemed to be the anatomical one.

GENERAL ANATOMICAL CONSIDERATIONS

The skin of the face and its subjacent fascia are intimately connected, forming the largest sheet of platysma type integument to be found in the body. The muscles of expression are found in the superficial fascia, take their origin from fascia except in a very few instances, and always insert into fascia. The motor innervation is through the seventh nerve; sensory fibers arise from the fifth.

The mobility of the occipitofrontalis muscle and its fascia is proverbial; the same mobility holds true for the superficial structures of the face. The most important facial muscles for our purposes are the orbicularis oris, the orbicularis palpebrarum, and the risorius (Fig. 1). The two latter are of importance because they insert into bone.

At the internal canthus we find the closest association between the skin and the underlying structures, and it is here that the orbicularis palpebrarum inserts into bone. The risorius takes its origin from the canine fossa connecting the superficial structures with the bone at this point. If we test the mobility of the skin and integument with the finger tip, we find five points at which the skin is very close to underlying bone or almost immobile on underlying bone. We enumerate (1) internal canthus, (2) symphysis mentis

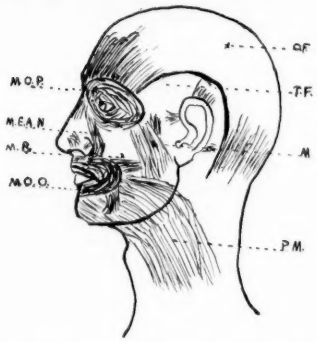

Fig. 1. Muscles of the face and scalp. *O.F.*, Occipitofrontalis; *T.F.*, temporal fascia; *M.*, masseter; *P.M.*, platysma myoides; *M.O.P.*, orbicularis palpebrarum; *M.E.A.N.*, elevator alæ nasi; *M.R.*, risorius; *M.O.O.*, orbicularis oris.

(3) inferior to the external auditory meatus, (4) angulæ alæ nasi, and (5) malar prominence.

The skin of the face varies tremendously in thickness, being thinnest over the eyelids and thickest over the point of the chin. In the dissecting room it is not uncommon to find hair follicles within 3 millimeters of the periosteum of the mandible.

FACTORS INCREASING THE MALIGNANCY IN INDIVIDUAL LOCATIONS

For the purpose of this discussion we will group those locations of greatest malignancy according to the underlying anatomical factor.

Group 1, underlying bone—
Internal canthus,
Malar prominence.
Group 2, underlying fascia—
Below the external auditory meatus,
Over the temporal region.
Group 3, underlying dense integumentum—
Angulæ alæ nasi,
Forehead and scalp.
Group 4, underlying cartilage—
Skin of nose,
Lower eyelid. Tarsal plate.

There are certain fixed points which determine the physical appearance of the face; if there were not, we would not be able to recognize our friends who become obese. A few points need be mentioned, the symphysis mentis, the internal canthus, the malar prominence, and a line joining it and the root of the zygoma. It would seem from this observation that either areolar tissue is lacking in these locations or that fibrous bands unite the integumentum and the bone. The last we believe to be the correct explanation.

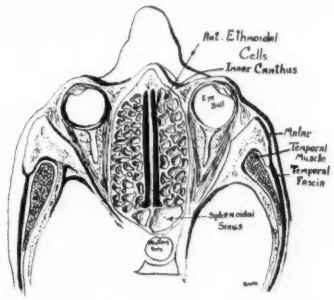

Fig. 2. Horizontal cross section at the level of the inner canthus. Note proximity of ethmoidal cells to inner canthus. Also proximity of temporal fascia to skin.

Carcinomata occurring in these situations possess several common characteristics: (1) they are erosive (truly rodent), (2) they are usually basocellular (50 per cent, 7), (3) they run a protracted course, (4) but are truly malignant—eventually causing death, if untreated, and (5) they heal superficially under apparently adequate treatment only to recur viciously.

Handley's method of direct extension applies peculiarly to this group of carcinomata.

Group 1, (a) the inner canthus. The skin is very thin in this region and the platysma muscle—the orbicularis palpebrarum—lies quite closely. We also have the tensor tarsi muscle with its ligamentous insertion into the inner wall of the orbit. This inner orbital wall is also the outer wall of the anterior ethmoidal cells (Fig. 2).

The short distance of 3 millimeters lies between the skin of the inner canthus and the ethmoidal cells. Having gained access to the ethmoidal cells, cure of carcinoma in this region is improbable. Exenteration of the orbital contents and of the ethmoidal cells *in toto* offers the only hope. Patients at this stage of the disease hesitate to sacrifice the eye. For this, they may not be censured. Radiological treatment may prolong life indefinitely — 10

Fig. 3.

Fig. 4.

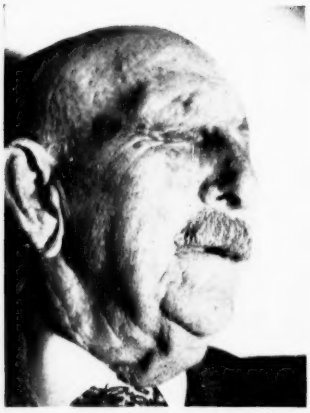

Fig. 5.

Fig. 3. Carcinoma over malar prominence.
Fig. 4. Basocellular carcinoma of 11 years' duration. Irresponsive to radiation.
Fig. 5. Senile keratosis in temporal region. At usual site for malignant invasion of subjacent structures.

years for example—without seriously interrupting the patient's occupation.

X-ray and radium therapy are usually the treatment of choice. Electrocoagulation is valuable especially in any exenteration of ethmoidal cells. The most neglected avenue of approach is through the nose by placing the radium in the superior meatus.

Group 1, (b) the malar prominence. The bony structures are not as superficial here as at the inner canthus, but this is one of the fixed points of facial contour, for beneath this point the fascia of the parotid—the masseter and the temporal fascia — attach themselves to the bone (Fig. 2).

At this point the subcutaneous structures are few, and so any infiltrating lesion can rapidly extend directly into the upper, outer border of the malar. Sante comments on this fact (Fig. 3).

Group 2, underlying fascia. (a) Below the external auditory meatus. The skin of the neck just below the lobe of the ear is very thin and delicate as attested by its frequency as a site of chronic eczema. Only the thinnest of superficial fascias separates the skin from the fascia of the parotid gland.

This narrow, concealed cleft is a center for the union of the parotid fascia; the fascia of the neck and the deep fascia of the mandible. In close proximity is the very superficial mastoid process. Most important of the subjacent structures is the seventh nerve; also the auricular artery and vein and the temporal artery and vein; while more deeply are the internal carotid artery, the internal jugular vein, and the vagus and phrenic nerves. A more dangerous operative site could not be imagined.

Strangely enough, carcinomata originating in this region involve the deeper structures but rarely erode them.

The parotid fascia constitutes the Thermopylæ of this region. Once penetrated by carcinomatous cells, cure is improbable. An extension of the parotid gland lies here and this affords a field for further growth while surface healing may occur. Trismus occurs, transiently at first, later permanently; subsequently the seventh nerve is involved and complete paralysis of the lower branches follows transient attacks.

Operative interference is impossible. Early cytocaustic radiation alone affords hope for cure. The course may extend over a period of 11 years (Fig. 4), with periods of healing and recurrence.

Group 2, (b) carcinoma of the temporal region. Subjacent to the skin in this region lies the temporal fascia. This is thick and fan-shaped

Fig. 6.

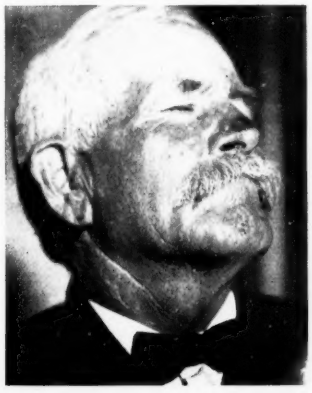

Fig. 7.

Fig. 8.

Fig. 6. Basocellular carcinoma of midline of forehead.
Fig. 7. Basocellular carcinoma of perichondrium of nose.
Fig. 8. Basocellular carcinoma involving the lower eyelid.

fascia and covers the temporal muscle, is inserted in the zygoma inferiorly and superiorly into the temporal ridge (Fig. 1). We also find the temporal artery and vein quite superficially in this region.

Early adequate treatment usually cures these carcinomata. The temporal region is a favorite site for senile keratosis and great care must be exercised in their treatment especially if any tendency to infiltration or erosion, the result of malignant change, is evident (Fig. 5). Infiltration and perforation of the temporal fascia again produces a wellnigh hopeless situation. Early lesions in this region should be electrocoagulated down to the fascia, the fascia exposed, and curetted clean. If this were always done, recurrence would be avoided except when the patient appears too late for treatment. Malignant fascial involvement spells disaster.

The course of the disease is fraught with frequent severe hæmorrhages from the upper and lower ends of the eroded temporal artery and vein. Sloughing and secondary infection are extensive. Progressive excavation and widening of the ulcerated area occurs. The upper border of the zygoma is exposed and of the adjacent orbital structures. Radiation is peculiarly ineffective. The recurrent hæmorrhages usually cause fatal termination.

Group 3, underlying dense integumentum. (*a*) *Angulæ alæ nasi.* At this point the nasal cartilages, the platysma facial muscles, and the risorius unite. This area is very thin as anyone may observe by placing the index finger beneath the upper lip and palpating externally with the other hand. At the same time, the fibers of the risorius may be palpated as they course downward to the canine fossa.

The integumentum is very dense and fibrous. One may very easily confuse the epidermoid type of lesion beginning on the skin in this region with a very radiosensitive type beginning in the nasal mucosa.

The epidermoid type is resistant to radiation and unless dealt with vigorously produces a chronic indurated ulcer which will not heal. The problems in these cases are extremely difficult—continued radiation tends only to increase the fibrosis without affording an opportunity for sufficient nutriment to cause healing to extend to the surface.

Group 3, (*b*) *the scalp.* The scalp is very large, embracing the area from the supraciliary ridges anteriorly to the superior curved line posteriorly. The traditional five layers are of great importance because the three thickest layers are very mobile. The fourth layer being loose, areolar tissue permits this motion.

The periosteum of the cranium forms the fifth layer and is termed the pericranium.

Lesions of the scalp are rather uncommon but are usually well advanced if they lie above the hat line. We have seen patients with extensive growths concealed for years from their families by the continuous wearing of a hat by the female or a skull cap by the male. The lesions above the hat line are of two types: (1) cauliflower with a small pedicle, and (2) an ulcerative, perforating type. The latter type is most malignant for the neoplasm will erode the skull, producing death by rupture of underlying blood sinuses.

The most common site for neoplasms of the scalp is the forehead, probably due to the exposure to sun and wind. These lesions begin as senile keratosis and progress very slowly and ulcerate late.

The occipitofrontalis fascia acts as an effectual barrier for a long time because of its tendinous avascular nature. Should the patient delay too long we find that the fourth and fifth layers have been penetrated, thus preventing any movement of the scalp in this particular area. Once the pericranium is involved, the subjacent bone also is a locus.

Treatment in these latter patients may be successful if thoroughly carried out. An area of the scalp at least 1 centimeter beyond the borders of the lesion must be excised by the electrocautery down to, and including, the pericranium. If the bone is not involved and the inner surface of the periosteum is normal, nothing more need be done unless the pathologist demonstrates internal involvement.

If early involvement is noted on the inner surface of the pericranium the outer table of the skull must be removed. This is not a formidable operation and is readily accomplished. Should there be involvement of the outer table, a complete section of the skull must be removed. This is the work of the neurologic surgeon.

Many patients may be cured by removing the pericranium, but this operation frequently leaves a denuded area of bone which epithelializes with difficulty. We have been very successful in aiding healing by drilling numerous holes in the outer table with the dentist's burr, allowing the drill to go just deep enough to secure seepage of serosanguineous fluid. Granulations rapidly grow upward and the epithelium spreads rapidly over this fresh surface (Fig. 6).

Group 4, underlying cartilage. (*a*) *The nose.* Lesions involving the underlying cartilage of the nose are very common but as they are so conspicuous they receive early and protracted treatment. There is probably no lesion so amenable to treatment and yet more universally incorrectly handled.

The earliest lesion is a flaking of the epithelium with a continued heaping up of the yellowish epithelial dèbris. The brownish surface discoloration seen in senile keratosis elsewhere is frequently absent. These yellowish oily flakes continue increasing in thickness and and if scraped off leave an irregularly pitted non-hæmorrhagic surface. At first bland, later irritating, ointments are prescribed by the average practitioner. In the course of time blood seepage occurs upon the removal of the crust and subsequent crusts become thicker and darker due to blood admixture. By this time the skin and underlying fascia are seriously involved. The cartilage is very resistant and does not become involved until quite late in the disease; however, once it becomes involved, mutilation is required to effect a cure (Fig. 7).

Massive X-ray dosage as recommended by Evans and Leucutia may result in cure but with the distinct danger of perichondrial damage. Continued small dosage is worse than useless. Electrodesiccation under local anæsthesia is the ideal method of therapy because it destroys the growth accurately with the minimum of mutilation. Cartilage can be removed accurately and quickly. Healing is rapid with little scarring. No patient so treated should be discharged as cured. Quarterly inspections are necessary and the radiologist should pay particular attention to the interior of the nose, for a recurrence may take place in the inside of the nose and not be visible on the outside.

Group 4, (*b*) *the lower eyelid.* Lesions of the lower eyelid may begin on the free surface of the skin or on the lid margin and may present a red, granular, raised surface which bleeds freely. This continuous hæmorrhage serves a

very useful purpose in that patients so afflicted seek adequate medical service early.

The treatment of choice is radium irradiation for the growths are basocellular and are very radio-sensitive. Great care must be exercised in applying the radium so that the entire field is treated, as recurrences are attributable to poor technique.

The tarsal plate offers the *piece de resistance*. Involvement of this cartilaginous structure increases the gravity of the prognosis. Of all the various types of lesions previously described, this is the most benign and responsive. It is the occasional deeply eroding, inadequately irradiated case which demands our attention (Fig. 8).

CONCLUSIONS

1. The anatomical factors influencing the prognosis in carcinomata of the skin of the face are reviewed.

2. An attempt is made to correlate the anatomical structures influencing the prognosis in varying situations and to group them for clarity.

3. Treatment is briefly reviewed.

We have tried to show that the histopathological picture is only one aspect of the disease and at present an overemphasized one.

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CLINICAL SURGERY

FROM DEPARTMENT OF GYNECOLOGY AND OBSTETRICS, CARNEY HOSPITAL

THE TECHNIQUE OF THE TRANSVERSE CERVICAL CÆSAREAN SECTION

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IN 1907, Frank, of Cologne, advised placing the incision in the lower uterine segment rather than in the body of the uterus in performing cæsarean section. This method had been devised for neglected, infected, and potentially infected women who could not be delivered through the natural passages. At first, the low or cervical cæsarean section received but little consideration. During the last 15 years, the available literature shows that this method is increasing in popularity and that in some clinics it has replaced entirely or almost completely the corporeal or classical type of cæsarean section. Because of the better results obtained by the cervical operation, its range of applicability has been increased to include the clean case as well as the infected one.

In the performance of cæsarean section, the lower uterine segment may be approached in one of three ways: (1) by the extraperitoneal route represented by the Latzko type of operation; (2) by the transperitoneal route, where the visceral and parietal peritoneum are united, creating a so called extraperitoneal space as described by Veit-Fromme-Hirst; (3) by the intraperitoneal route, in which case the bladder is separated from the lower segment, an incision is made in the cervix, which, after delivery and closure, is covered over by the bladder, thus making the uterine incision retrovesical, retroperitoneal, or subperitoneal.

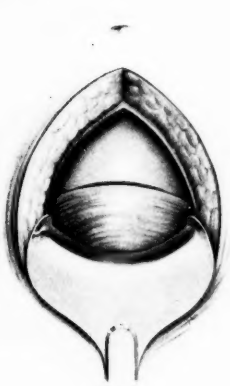
This last type of operation is the one in common use today. The cervix may be opened by a longitudinal or transverse incision. The success of the operation, in so far as good healing is concerned, depends upon placing the entire incision within the limits of the lower uterine segment. In making the incision longitudinally, it is possible to extend it into the body of the uterus when delivering a voluminous fetus. This may result in a weak spot at the upper end of the incision as I have observed it. The transverse incision offers three distinct advantages, namely: (1) it avoids encroaching upon the uterine musculature and allows the placing of the incision entirely in the lower segment; (2) the bladder separation does not have to be carried as far downward; and (3) repeated operations are simpler to perform.

After personally performing 427 cervical cæsarean sections, 220 with a longitudinal incision and 207 with a transverse incision, my preference is decidedly in favor of the latter.

TECHNIQUE OF THE TRANSVERSE CERVICAL CÆSAREAN SECTION

First step. Abdominal incision. The patient is catheterized, anæsthetized, and placed in the Trendelenburg position. The abdomen is opened by a median incision about 6 inches long, starting at the symphysis and ending near the umbilicus. The peritoneal cavity is entered between the bellies of the recti muscles. A Doyen retractor is introduced at the lower angle of the incision and the lower uterine segment is well walled off with a long strip of gauze. One cubic centimeter of gynergen is injected in the thigh muscles at this time.

Second step. Cervical incision, delivery. The uterine peritoneum, where it is loosely attached above the bladder reflection, is incised transversely and the bladder is pushed downward. The Doyen retractor is now placed over the bladder to protect it. The assistant makes traction upward on the uterus to bring the lower segment near the surface. A small, transverse incision is made with a knife, as low as possible in the cervix, in the median line; this is extended laterally with bandage scissors, curving the incision upward. This is done so as to give more room. The child is delivered by raising the head with the hand and making pressure on the fundus. Forceps are rarely necessary. If the breech presents, the infant is naturally extracted by the



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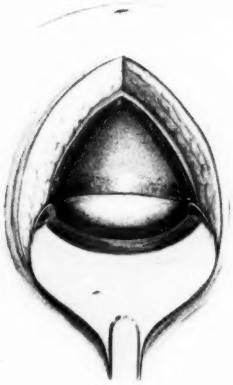

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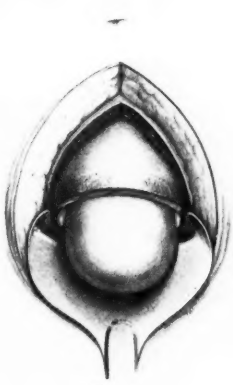

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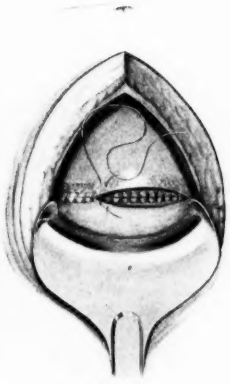

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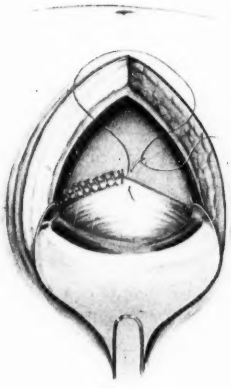

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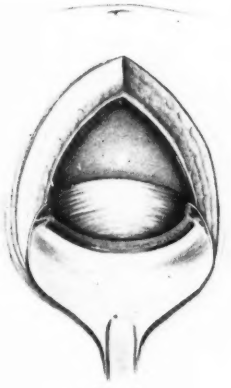

Fig. 6.

Fig. 1. Median suprasymphyseal incision exposing the lower uterine segment. The visceral peritoneum is incised transversely where it is loosely attached slightly above the bladder reflection.

Fig. 2. A flap of peritoneum is separated with the bladder which is held under the symphysis by a Doyen retractor. A curved transverse incision is made in the lower segment with bandage scissors to protect the child's head. The membranes are pouting through the incision.

Fig. 3. The vertex is delivered by raising it with the left hand and making pressure on the fundus with the right hand. In breech presentations the child is delivered by making traction on the feet.

Fig. 4. The cervical incision is sutured in two layers, the first with interrupted sutures, the second with a continuous stitch burying the first layer. No. 2 chromic catgut is used throughout.

Fig. 5. The edge of the bladder peritoneum is sutured to the uterus, in the middle line, at a point above the cervical incision. The two ends of the stitch are left long and attach the bladder peritoneum to the uterus on one side, then on the other. The cervical incision is now retrovesical.

Fig. 6. As the uterus contracts the bladder rolls over the lower uterine segment so that no catgut is exposed to the general peritoneal cavity.

feet. One cubic centimeter of pitocin is injected in the thigh muscles at this time. If the patient has had no labor, or if the cervix is but slightly dilated at the time of delivery, the placenta and membranes are expressed through the incision. If, on the other hand, the cervix is fully dilated, the cord is dropped in the uterus and the placenta is expressed through the vagina after the closure of the cervical incision and the suture of the peritoneal flap to the uterus. There is very little hæmorrhage from the transverse incision.

Third step. Closure of the cervical incision and suture of the peritoneal flap. The cervical incision is closed in two layers, the first with interrupted

sutures and the second with a continuous suture, No. 2 chromic catgut being used; the first layer takes in the endometrium and part of the muscle; the second layer takes in the remainder of the myometrium and the fascia of the lower uterine segment and completely covers the first layer. The peritoneal edge at the bladder reflection is now sutured to the uterus above the cervical incision in the middle line with a suture of No. 0 chromic catgut, the ends of the catgut being left long, one end approximating the peritoneum to the uterus on one side and the other to the other side, thus completely covering over the transverse cervical incision and making it entirely retrovesical.

Fourth step. Closure of the abdominal wall. The gauze strip is now removed, the omentum is brought down (intestines are practically never seen during this operation), and the abdominal wall is closed in layers in the usual way.

This operation may be readily performed under local infiltration and spinal anæsthesia. For local anæsthesia a 1 per cent solution of novocain is employed. For spinal anæsthesia, depending upon the weight of the patient, 100, 120, or 150 milligrams of sterile novocain crystals are dissolved in 2 to 3 cubic centimeters of spinal fluid and reinjected. Solutions of novocain lighter than spinal fluid are never employed in our department.

FROM THE SURGICAL CLINIC OF THE MEDICAL COLLEGE OF VIRGINIA

OPERATION FOR TUMORS OF THE BLADDER

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PAINLESS or nearly painless hæmaturia calls always for a thorough urological study. When through the cystoscope we see a bladder tumor, even of small size, located at some distance from the ureteral openings, excision of the portion of bladder involved will be the logical treatment, provided that to do so would not entail special danger of the operation itself. Tumors located so close to the ureteral orifice as to make wide excision impracticable without added risk from injury of the ureter may call for the use of fulguration of the tumor with fair prospects of cure, but few surgeons would feel as much satisfaction after treating such a tumor by fulguration as if a wide excision could have been performed.

For extensive bladder tumors of long standing, radical cure is not apt to be possible unless complete removal of the bladder and transplantation of the ureters may prove to be effective.

For tumors located at a safe distance from the ureters, especially in the fundus of the bladder, operative excision is today the method of choice. There are two dangers, however, in attempting to remove bladder tumors through an ordinary extraperitoneal incision into the bladder: one that removal of the tumor would entail accidental opening of the peritoneal cavity, the other that when guarding against this accident, the tumor may not be completely removed. Incomplete operations for cancer of any organ are followed by rapid spread of the malignant disease.

In January, 1930, Herbert Sugar in SURGERY, GYNECOLOGY AND OBSTETRICS, described a method of securing a complete exposure of the entire bladder, which he attributes to Voelcker.

I employed this method first in May, 1930, and again in January, 1931, in two patients both of whom had large cancers of the fundus of the bladder. In both cases the operation was quite easy of performance; the electrosurgical needle was employed satisfactorily for making excision, convalescence was totally uncomplicated, the patients were out of bed in 10 days, and the wounds were healed in 2 weeks. It is now more than a year since the first patient was operated upon. He has no sign of local recurrence or distant metastasis, and he works hard and considers himself in good health.

STEPS OF THE OPERATION

Spinal anæsthesia is employed, and the patient is placed in the Trendelenburg position. The skin, muscle, and fascia are divided in a transverse direction. The linea alba is divided to a point an inch or two above the transverse incision through the fascia, and the recti and pyramidales muscles are easily separated by retractors. The prevesical fat may be brushed aside, thus bringing into good view the flap of peritoneum which is attached to the top of the bladder quite tightly. No attempt should be made to separate this area of peritoneum at its point of attachment to the bladder on account of the liability of tearing the peritoneum. Instead, the peritoneal cavity is deliberately opened in the transverse direction, by an incision which is carried to each side, 1.5 to 2 inches. With the bladder caught at its top by forceps and pulled upward, another incision is made through the peritoneal covering of the bladder at a point about 2 inches below its highest attachment. With a knife handle or gauze covered finger, the peritoneal covering, except at the vertex, can be brushed down with surprising ease, so that the entire bladder is extraperitonealized down to the rectum and the ureters and large vessels are brought into view. When this is done, the bladder is held up, and the peritoneal cavity is closed, with great pains to place the sutures close together and the edges in neat apposition. A gauze sheet is now placed over the line of

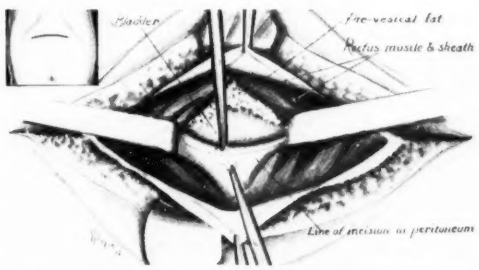
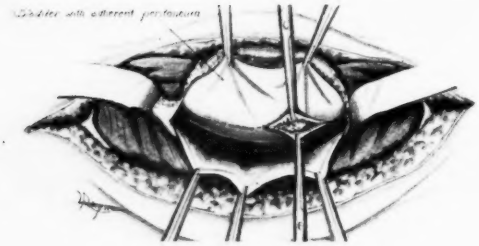


Fig. 1. The transverse incision is made through the skin, fat, and deep fascia. The lower recti and pyramidales muscles are pulled apart, the prevesical fat is brushed down, the peritoneum is exposed and held on forceps preliminary to transverse division.



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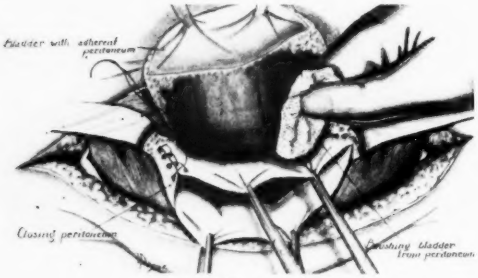

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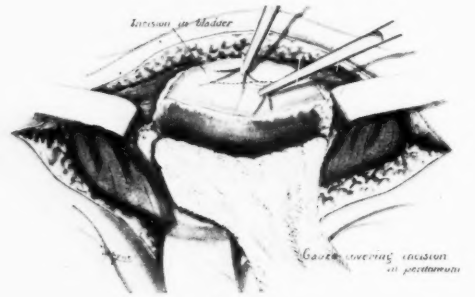
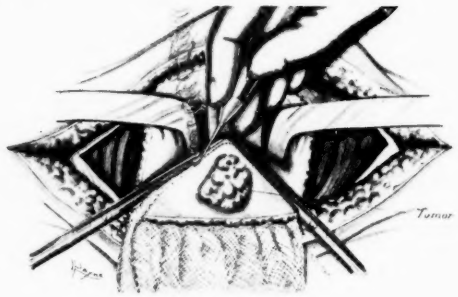


Fig. 4.

Fig. 2. Incision has been made in the peritoneal cavity, and the peritoneum covering the bladder has been divided about an inch below the top of the bladder and it is now being peeled off from the bladder.

Fig. 3. The peritoneum has been brushed completely off down to the neck of the bladder, and the peritoneal cavity is being closed while the bladder is being held up.

Fig. 4. The peritoneum is now closed, a gauze sheet is placed over the suture in the peritoneum to prevent contamination after the bladder has been opened at the fundus.



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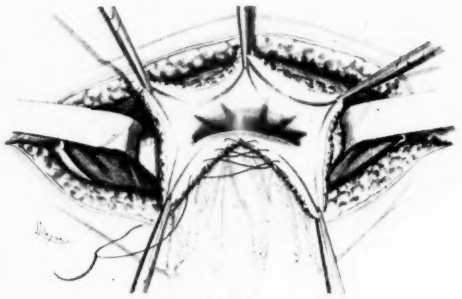

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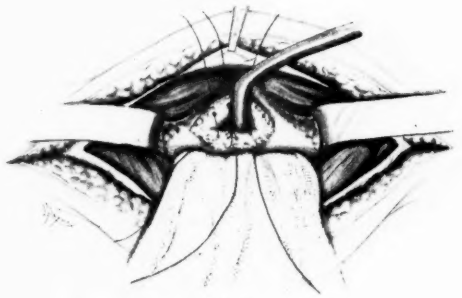

Fig. 7.

Fig. 5. The bladder has been opened, a large area of the bladder surrounding the tumor is held between clamps and is being excised by electrosurgical needle.

Fig. 6. After excision of the large area of bladder around the tumor the bladder is being sutured.

Fig. 7. The opening in the fundus in the bladder is being closed around a small suprapubic drain.

sutures into the large space made by enucleation of the bladder to protect the line of sutures and cellular tissue against contamination in the next step of the operation, namely, the opening of the bladder.

The bladder is opened at the uppermost portion and a thorough inspection of the entire interior is made. A wide area of bladder surrounding the tumor in all directions is clamped off as shown in the illustrations, and with an electrosurgical cutting instrument, an area (in my 2 cases an area the size of the palm of one's hand) is excised with a coagulating current, each edge is touched in other locations, and finally the forceps with which

it is clamped are touched several times with the electric instrument to coagulate the tissue and prevent bleeding. The forceps are now removed and the edges of the bladder sutured first by a so called "baseball" stitch, and over this a simple running suture is applied from behind, as a means of making snug apposition and further to control bleeding.

A small right angled suprapubic drain is placed in the bladder and the bladder is closed snugly about this tube. We have not employed drainage into the extravesical space from which the peritoneum has been separated.

One of our patients was 45 the other 70 years old. In one the growth was considerably larger than a silver dollar, and was of the infiltrating type; in the other it was slightly larger than the distal phalanx of a large thumb and had a broad pedicle. Both tumors upon microscopic examination were shown to be carcinomata.

A SECOND CÆSAREAN SECTION AFTER BILATERAL URETERAL TRANSPLANTATION INTO THE SIGMOID

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From the Department of Obstetrics and Gynecology, University of Michigan

IN October, 1928, in SURGERY, GYNECOLOGY AND OBSTETRICS, Eberbach and Pierce reported a case of bilateral ureteral transplant for exstrophy of the bladder which operation was done in 1923. The technique employed was essentially that developed by Coffey. The few modifications made were described in the previous report.

In August, 1927, the patient entered the University Hospital, pregnant at term. The day following admission labor pains began. Because the symphysis was separated about 4 inches and because there was so much scar tissue in the vagina, a classical cæsarean section was performed. A normal female child, weighing 5½ pounds, was delivered. The patient's convalescence was normal and she was discharged on the seventeenth day. Throughout the pregnancy and convalescence no evidence of pyelitis or nephritis was noted.

January 22, 1930, the patient again entered the University Hospital pregnant at term. The membranes had ruptured a few hours previously and labor pains had begun. A classical cæsarean section was performed immediately. At the request of the patient and her husband, a sterilization was performed at the same time. This was done by excising and closing the uterine cornua and by burying the uterine ends of the tubes upon the posterior surfaces of the broad ligaments.

The baby was a male child, weighing 6 pounds. It was normal except for a mild degree of hypospadias; only the prepuce being split down to the frenum.

During the sixth, seventh, and eighth days after operation, the patient's temperature rose to 100.5 degrees F. Temperature returned to 98.6 degrees F. on the tenth day and remained so until her discharge on the seventeenth day.

When the patient left the University Hospital in 1927, she was instructed to report to the clinic or her family physician at frequent intervals, and the latter was asked to look for signs of pyelitis. The patient reported both to the clinic and to her physician, and at no time before or during her second pregnancy were there any signs of either pyelitis or nephritis. Without going into the question too deeply of what causes pyelonephritis after rectal implantation of the ureters, it may be stated that experimental and operative experience shows that ascending pyelonephritis will not follow unilateral or bilateral ureteral transplantation if the ureters are not dilated and the implanted end of the ureter is not constricted. At no time during her convalescence was there any costovertebral tenderness and her blood pressure varied between 110.75 and 122.78 millimeters mercury. Her convalescence was practically afebrile. From these facts we feel that one is safe in assuming that if there was any pyelitis it was very mild.

As was stated in the previous report, no definite conclusions can be drawn from a single case, but it would seem that the transplantation of the ureters into the sigmoid is not a contra-indication to pregnancy. It would also seem that if there were a pyelitis present symptoms would surely appear during pregnancy. These facts should be of great importance to the gynecologist who sees cases of exstrophy of the bladder and incurable vesicovaginal fistulæ in young women, who can be restored to society only by bilateral ureteral transplantation.

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GYNOPATHIC BACKACHE

A Study of Its Nature and the Mechanism of Its Production; with Special Reference to Uterine Retroversion[1]

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IN the entire range of subjective gynopathic manifestations, backache is one of the most familiar and least understood as to its nature, its direct cause, and the mechanism of its production.

Ward, quoting from the records of the Woman's Hospital in New York, states: "Our statistics show that approximately 85 per cent of our gynecological cases complaining of backache are caused by gynecological pelvic disease and the remaining 15 per cent by orthopedic or non-surgical conditions."

Lynch, in an analysis of 1,041 gynecological cases, found that, "49 per cent had sacral or lumbar backache; of these, 76.5 per cent were due to a gynecological condition, 7 per cent were of doubtful etiology and 16.5 per cent were definitely orthopedic."

This prevalence of backache in gynopathic conditions has so habituated us to their concurrence that a direct relationship of a condition and a symptom is tacitly accepted without further investigation as to the how and why the one produces the other.

Gynecological literature is very indeterminate on this phase of the subject, the prevailing concepts being based largely upon various conjectural implications of purely concomitant factors, none of which exhibit that constancy of clinical parallelism essential to establish the direct relationship of cause and effect.

Ward's paper, the most recent and comprehensive résumé of these prevailing concepts states: "The most frequent direct cause of gynecological backache is pelvic congestion. Any condition that will produce this state is an etiological factor, as, for example, retrodisplacements with and without complicating inflammatory disease, lacerated cervix with cervical infections, menstruation, and constipation." Continuing, Ward enumerates:

"Traction on ligaments and supports of the pelvic organs, pressure from fibroids, cysts and exudates on the cervical ganglia of the sympathetic nervous system in the region of the cervix, rectum and uterosacral ligaments and on the roots of the sacral nerves as productive of referred backache."

Bullard, in a statistical study of 721 cases of backache from the service of the Woman's Hospital in New York, pointedly comments on 125 cases of the series, "47 of which presented adherent retroversion with inflamed adnexa; 20, uncomplicated mobile retroversion; 20, prolapse of varying degree; 9, of procidentia; and 29 complex cases, not one of which complained of backache."

It is noteworthy, that this group of cases, embodies every alleged causative factor of backache and yet not one of the group complained of backache.

More significant is the item in Bullard's analytical summary of his statistics, which shows, that in "15 cases out of every hundred, the backache persisted after otherwise successful correction of gynopathic conditions."

These quotations from the current literature will suffice to reveal, first, that the majority of gynopathic patients suffer from backache; second, that a lesser number, presenting identical lesions, do not suffer from backache; third, that an appreciable number are not relieved of their backache by apparently successful corrections of their gynopathic disorders.

What the literature does not reveal is: how the backache is produced in the first class; what particular factor determines its absence in the second; and finally, why apparently successful corrections fail to relieve the third class.

The modern trend of advanced clinical procedure subjects every regional manifestation of disorder to a most searching analysis of its various phases: critical inspection, accurate localization, chemical and biological aids are invoked in tracing the links from cause to effect and yet, how many gynecologists direct even a single glance of superficial inspection to the aching back of a gynopathic patient until its postoperative persistence impels a closer search for its cause?

THE NATURE OF GYNOPATHIC BACKACHE AND THE MECHANISM OF ITS PRODUCTION

Primarily, a gynopathic backache is essentially an intermittent attitudinal spastic backache, characteristically located at the sacrolumbar

[1] Read before the Gynecological Section of the New York Academy of Medicine, April 22, 1930.

articulation, involving the lower erector spinæ and upper iliopsoas muscle segments which control the mobility of the sacrolumbar articulation.

This spasticity is a reflex protective immobilizing phenomenon, analogous to that found in the anterior abdominal wall, pathognomonic of deep seated, irritative processes.

If a mild galvanic current be applied to the normal sacrolumbar musculature, it induces no painful response; the same current applied to the gynopathic back intensifies the spasm and augments the pain—a test for myospasm familiar to neurologists.

It is not generally recognized that, normally, the sacrolumbar articulation and its resulting pelvic tilt do not present a fixed, but a constantly varying, angle. While the adult spine as a whole presents apparently fixed contours, it is nevertheless very flexible, especially in its lumbar segments. This flexibility is due to the elastic resiliency of the intervertebral discs.

Dwight, quoted by Whitman states: "The intervertebral discs constitute 41.9 per cent of the cervical; 26.4 per cent of the dorsal; and 44.6 per cent of the lumbar region where the widest movements of the trunk are carried out." Thus under normal conditions, the sacrovertebral angle with its resultant pelvic incline is subjected to constant adaptive variations, the pelvis dipping and rising with every contraction of the sacrolumbar musculature in automatic response to all postural and attitudinal demands.

These physiological contractions of the sacrolumbar musculature become pathologically spastic in the presence of intrapelvic disorder, the purpose of the spasticity being a protective immobilization of the pelvis at an angle posterior to the perpendicular line of intra-abdominal pressure; in other words, a painful spastic augmentation of the normal pelvic dip occurs, which deflects and minimizes pressure from above.

The dynamic resultant of this deflection between the abdominal and pelvic cavities is convincingly demonstrated by G. H. Noble who, in a study of "Intra-abdominal Dynamics etc." states: "Normally an intra-abdominal pressure of 80 millimeters at the pelvic brim is reduced to 60 millimeters at the cervix, 40 millimeters in the vagina, and 20 millimeters at the vulvar outlet." In other words, the force of intra-abdominal pressure is reduced to one-fourth of its initial intensity by intrapelvic deflection.

The myospasm exaggerates the lumbar curve, narrows the lumbosacral angle, rotates the promontory down and forward, the coccyx up and backward on a transverse axis, thus interrupting the direct continuity between the pelvic and general abdominal cavities.

Omitting all further delineation of the reciprocal and harmonious deflections of pressure, exercised by the pelvic planes and pelvic floor musculature, the details of which are fully elaborated in another publication (10), it will suffice here to state concretely that the promontory of the sacrovertebral angle may be likened to a hinged watershed, which automatically changes its angle to divert pressure from above, the hinge becoming spastically locked in the presence of gynopathic conditions.

Obviously, the range of flexibility in the sacrolumbar angle must be dominated by the structural conformation of the individual spine.

Routine examination of spinal contours will reveal a wide divergence in anteroposterior outlines and mobility, which is most pronounced in the sacrolumbar area, since the lumbar curve varies in different spines from an almost rigid, flat vertical to a concavity bordering on the lordotic.

In an illuminating contribution on this subject, Dickinson and Truslow characterize the two extreme anteroposterior spinal deviations from the normal as the "kangaroo and the gorilla types."

While the illustrations in Figure 1 are purely schematic, they indicate, first, the variants in the individual depth of the sacrovertebral angle among different spines; second the dominance of this angle on the pelvic tilt; third, the influence of the pelvic tilt on the direction of the axis of the pelvic inlet. The nearer the oblique axis of the pelvic inlet approaches the vertical, the greater the intensity of direct intrapelvic pressure from above.

Such marked deviations in structural conformation necessarily imply a corresponding diversity in functional mobility and it follows as an obvious corollary that the wider the mobility range the less strain upon the lumbosacral musculature in tilting the gynopathic pelvis out of the vertical line of intra-abdominal pressure, and conversely, the more limited the mobility, the greater the muscle strain with eventual spasm productive of pain. This explains why among different patients with identical gynopathic disorders, some suffer slight backache, some severe, and others not at all.

A trained female contortionist with gynopathic disorder would be less likely to suffer from sacrolumbar myospasm than a similarly afflicted seamstress.

BACKACHE AND RETROVERSION

Clinically, uterine retroversion, as a potent factor in the causation of backache continues to dominate gynecological practice; while, academically, this concept invokes the most contradictory expressions of opinion. Thus, Jaschke, quoted by Ward, after comparing 1,000 cases of retroflexion with 1,000 cases of anteflexion, affirms that "there is no symptomatic difference to be noted in the two forms."

Theilhaber, of Munich, and Cabot, of Boston, quoted by Ward emphasize the existence of "symptomless, uncomplicated retroversion of the uterus."

Graves, on the other hand, in an analysis of 500 cases of "retroversion from all causes," states that "sacral backache was a definite symptom in 76 per cent." He concludes that "there can be no doubt whatever of the fact that retroversion of the uterus does cause backache."

Operative gynecology to date records over 100 detailed methods for the correction of uterine retrodisplacements. Every one of these methods, at the hands of its promulgator, will undoubtedly convert the retroposed into an anteroposed uterus, but notwithstanding their faultless postoperative uterine poise, a number of these patients continue to suffer from backache and some more so.

Bullard estimates that 15 per cent of the surgically corrected retroversions continued to suffer from backache.

Hurd, in a recent publication, states: "The question as to what percentage of all varieties of retroversion gives rise to symptoms would appear to be a difficult one to answer and could be solved only by routine pelvic examination of a large series of women taken at random."

In this tabulated study of 1,000 patients with retroversion, Hurd found only "17 per cent" who complained of backache and he concludes that "this series fails to verify the generally accepted teaching that backache is a classical complaint in simple retroversion."

In this series of 1,000 cases representing the various types of operations in vogue, Hurd reports: "40 immediate anatomic failures, a series of late recurrences after an average period of 10 months, and complete symptomatic failures in 12 per cent of the patients." He incidentally interpolates a very relevant observation with regard to the anatomic failures, namely, that 3 out of 5 were relieved of the symptoms for which they were admitted, regardless of the recurrence of the displacement.

A most significant observation, for it justifies the conjecture that the relief of backache attributed to the surgical correction of uncomplicated mobile retroversion, is a *post hoc ego propter hoc* assumption in three-fifths of the cases and it would seem reasonable to contend that correctly applied pessaries would have yielded the same results.

The controversial crux in the problem centers in the question: Where does normal uterine poise end and pathogenic retroversion begin?

A definite answer to this question will be reached only when the dynamic factors that dominate intra-abdominal topography in general and uterine poise in particular are more clearly visualized.

The prevailing concept of normal uterine poise is based exclusively upon purely anatomic details which do not reveal the mechanism involved in the maintenance of this poise.

Uterine poise is not simply a question of ligamentary or musculofascial support. There is not a ligament or muscle attached to the uterus that could permanently resist the displacing force of intra-abdominal pressure and the active physiological expulsive power normally manifested within the pelvis.

A force capable of expelling a full term fetus would permanently displace an empty uterus with every strain at defæcation unless minimized or dispersed by deflection. The ligamentous and musculofascial elements serve to maintain uterine poise, *not* by virtue of their structural resistance to displacement, but as integral parts of a complex mechanism that deflect the displacing force of intra-abdominal pressure.

The term normal uterine poise must be conceived as a purely relative and not as a positive designation. The structure, form, and topographic relations of the uterus necessitate a range of mobility that reaches normally from the symphysis to the sacral promontory. In infancy its long axis approximates the vertical, which gradually descends through an arc of 45 degrees to form a right angle to the plane of the pelvic brim at maturity.

This developmental change of poise is not due to a forward and downward rotation of the fundus, but to a downward and backward rotation of the pelvis at the sacrolumbar junction.

"If an infant be placed on its back and its legs be drawn down from their habitual attitude of semiflexion, it will be noticed that the range of extension is limited by the absence of the lumbar curve and pelvic incline. When gain in the muscular development enables the infant to stand, the erector spinæ draws the trunk upward against the resistance of the iliopsoas group and ligaments

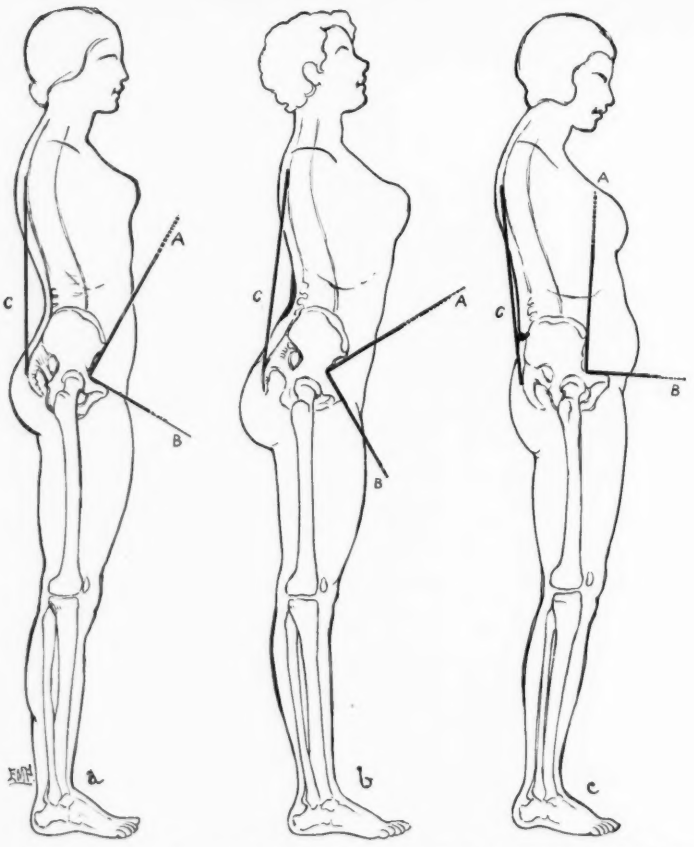

Fig. 1. a, Normal lumbosacral angulation. The axis *A*, 60 to 65 degrees. b, Excessive lumbosacral angulation. The axis *A* inclines to the horizontal. c, Flat lumbosacral angulation, infantile type. The axis *A* inclines to the vertical. *A*, Axis of the plane of the pelvic brim. *B*, Plane of the pelvic brim. *C*, Vertical showing difference in the depth of the lumbosacral angulation. Note that in each type of lumbosacral angulation the uterus normally assumes the poise in which its long diameter coincides with axis *A*.

of the hip-joint, bending the lumbar spine into its physiological curve." (Whitman, 6.)

In other words, under normal development, the erect attitude is attained by a forward flexure of the lumbar spine, the pelvis thus assuming an angle of 60 to 65 degrees with the tip of the coccyx on a horizontal level with the lower border of the symphysis pubis.

In conditions of arrested development, the upright attitude is induced, not by flexure of the lumbar spine but by a vicarious upward rotation of the entire trunk on the femoral joints, the pelvic brim maintaining the infantile vertical axis.

Every stage of arrested development in the normal backward tilt of the pelvis must of necessity be reflected in a corresponding tilt of the uterus. In such vertical pelves, the only tenable position for the uterus is vertical and leaning to retroversion.

Concisely stated, uterine poise is the resultant of deflected intra-abdominal pressure. The entire abdominal cavity constitutes a complex deflecting chamber presenting multiple planes, some of which are fixed, others mobile, that deflect pressure at various and varying angles to each other along fixed and definite lines.

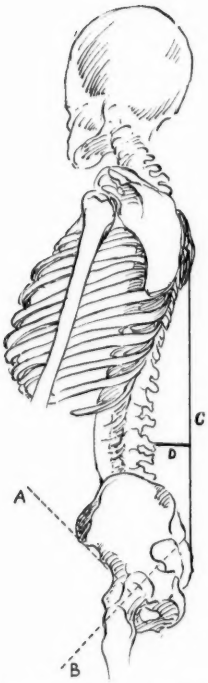

Fig. 2. *A*, Axis of plane of pelvic brim. *B*, Plane of pelvic brim. *C*, Vertical. *D*, Lumbosacral angle. Note that the depth of the lumbar curve *D* is an approximate index of the lumbosacral angle and its resultant pelvic incline.

Fig. 3. The edge of a ruler held vertically in contact with the spinous processes of the lower dorsal and sacral vertebræ spans the intervening lumbar hollow. The distance in millimeters from the deepest point of this hollow to the anterior edge of the ruler presents an index of the lumbosacral angle with its resultant pelvic incline and indicates the uterine poise normal to that incline.

In the pelvis, the osseous or fixed planes may be designated expulsive planes inasmuch as they tend to deflect the direction of pressure into line with the pelvic outlets. The familiar action of these planes in parturition may serve as an apt illustration of their dominating influence within the pelvis.

In the same sense, the musculofascial or mobile planes are retentive in so far as they deflect or diffuse pressure in directions that tend to maintain the topographic stability of the pelvic organs.

According to a fundamental law in dynamics, "The direction of a given force impinging against a resistant plane becomes deflected in a fixed and definite direction, the angle of deflection being governed by the angle of the resistant plane." It follows as a natural corollary that uterine poise is determined by the individual pelvic poise, the long axis of the normal mobile uterus always coinciding with the axis of the plane of the pelvic brim. Every degree of pelvic angulation at the sacrolumbar junction determines a coincident angle of uterine poise through an arc ranging from the symphysis to the sacral promontory; hence, as one sacrolumbar angle with its resultant pelvic incline differs from another so the incline of the uterine poise must differ one from another, and what is normal in the one is abnormal in the other.

Every degree of sacrovertebral angulation is necessarily evidenced by a corresponding depth of the lumbar hollow, which thus presents an approximate, measurable index of the pelvic tilt as a whole and incidentally indicates the uterine poise normal to that angle.

To obtain this index, the patient with back exposed assumes her natural relaxed standing attitude, while the edge of a ruler, held vertically in contact with the spinous processes of the lower dorsal and sacral vertebræ, spans the intervening lumbar hollow (Fig. 2).

The distance in millimeters from the deepest point of this hollow to the anterior edge of the

ruler presents an index of the lumbar curve and incidentally the degree of lumbosacral angulation with its resultant pelvic tilt. In taking this index, it is essential that the ruler approximates a true vertical.

In an extensive series of observations, this lumbar index ranged from 10 to 45 millimeters (9).

An index of 20 millimeters marks the extreme minimum compatible with normal anterior uterine poise. From 20 millimeters down, the existence of a congenital retroversion of the uterus may be predicated in the majority of cases, prior to its objective verification.

The occasional exception to this rule will on closer investigation reveal a kyphotic dorsal spine, an abnormally projecting sacral promontory, a markedly contracted conjugate diameter, a congenitally elongated cervix, a strained and deceptive pose assumed by the patient during the measurement, or an acquired anteversion from co-existing gynopathic conditions, for it is only reasonable to assume that, just as a normally poised uterus may become retroverted, so a congenitally retroposed uterus may become pathologically anteverted without invalidating the significance of the lumbar index.

In the infant, a flat lumbar hollow is normal; in the adult it presents an arrested development and denotes a vertical pelvis. In these vertical pelves, the uterus necessarily assumes a poise leaning to retroversion and any procedure which converts such a retroposition into an anteroposition converts a compensated into a decompensated equilibrium among the pelvic contents. An uncomplicated mobile retroversion can not cause backache any more than an uncomplicated mobile anteversion, both phases of uterine poise being individually normal to their respective type of lumbosacral conformation.

This class of patients presents not only a shallow or flat lumbar curve, but the general skeletal contours typical of the visceroptotic habitus, in which backache is caused, not by their uncomplicated, mobile retroposed uterus, but "by the continuous attitudinal strain induced through constant automatic efforts to maintain an unstable poise within the lines of gravity." (Truslow, 3.)

These congenital retropositions offer the most legitimate field for relief by correctly applied pessary and abdominal supports.

Dynamically related to this class are the backaches induced by the lordotic attitude necessarily assumed by patients with pendulous abdomen and those subject to the constant static oscillation due to the use of excessively high heeled footgear.

It would appear superfluous to enumerate, for the sake of differential completeness, all of the well recognized orthopedic, neurogenic, toxic, and other extragynetic conditions productive of sacrolumbar pain, any of which may enter the problem in the given case as the sole or complicating etiological factor.

SUMMARY

Gynopathic backache is a spastic backache, the gynopathic factor being one among many causes of myospastic pain in the lumbosacral area.

This form of myospasm is a protective phenomenon, analogous to that observed in other muscular areas over deep seated irritative lesions.

It protects the inflamed pelvic viscera by tilting the pelvis out of the direct line of intra-abdominal pressure.

A normal range of mobility at the sacrolumbar articulation responds to this protective demand without undue muscle strain and hence without pain.

On the other hand, any structural or functional limitation of the essential mobility range in the sacrolumbar joint induces muscle strain manifested by spasticity and pain.

The relative degree of restriction in lumbosacral mobility, will determine the intensity of the muscle strain and its resulting pain.

The conformation of the sacrolumbar angle determines the angle of uterine poise. The term normal uterine poise is purely relative.

The poise of the uterus is normal when its long axis coincides with the axis of the plane of the pelvic inlet.

As this axis varies with the angle of the individual sacrolumbar junction, so the uterus presents its coincident variation in poise, ranging from the symphysis to the sacral promontory. A uterus in this poise does not cause backache and its surgical anteversion does not cure backache.

The depth of the lumbar hollow offers an approximate index of the sacrolumbar angulation and its incident uterine poise.

A mobile retroversion at an angle *not* coincident with the axis of the plane of the pelvic inlet presents a pathological displacement, in which, *not* the displacement as such but the cause of the displacement is the cause of the backache.

Finally, Mills in an exhaustive orthodiagraphic study of "Bodily Habitus in Relation to Visceral Form, Position, Tonus and Mobility," concludes that "Certain types of physique are associated with definite types of visceral topography."

All these types are adaptively compatible with normal function and comfort.

This dictum applies with equal validity to uncomplicated mobile retroversion in relation to gynopathic backache.

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A SURGICAL APPROACH FOR THE REMOVAL OF CERTAIN PINEAL TUMORS

Report of a Case

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THE sum total of medical literature pertaining to the surgical treatment of pineal gland tumors is extremely small. The reasons are obvious. In the first place, tumors of this gland are relatively uncommon. In the clinic of Dr. Cushing there were, in 1925, records of 12 histologically verified cases or approximately 1 per cent of the total number. Only 81 well described cases have been found in the literature. Very few of these cases were ever treated surgically. Then too, the incentive to report surgical measures taken for the removal of any tumor, if unsuccessful, is not great.

In 1913, Rorschah reported an attempted extirpation through the posterior fossa with a fatality. In 1914, Pussep attempted an extirpation by an approach above the cerebellum, dividing the right lateral sinus and the tentorium. The attempt also was unsuccessful. In 1921, Dandy reported the exposure of 3 tumors, localized by ventriculography in the region of the pineal gland, through an approach whereby he retracted the right hemisphere laterally, divided the posterior portion of the corpus callosum, and entered the third ventricle from above. One of these tumors exposed proved to be an infiltrating glioma of the cerebellum, and no attempt was made to remove it. The second proved to be an encapsulated "tubercle" of pineal gland. This was removed *in toto*. The patient survived 8 months. The cause of death was supposed to have been other tubercles in the brain. The third patient died some 48 hours after an operation at which the tumor was removed *in toto*. The tumor in this instance was a true pinealoma.

Far more frequent than the radical removal of these tumors have been simple palliative measures directed toward the relief of symptoms of an internal hydrocephalus. Such measures have consisted of simple subtemporal decompressions or attempted fistula formations between the third ventricle and the subarachnoid space at some point. This last procedure is worthless inasmuch as the fluid drains into the subdural spaces where absorption is almost nil. The fistulæ soon close. A simple right subtemporal decompression supplemented by vigorous deep therapy radiation may hold the growth of some small pineal tumors in check for a number of years. A few patients have lived for several years with a decompression only. However, most of the patients with pineal tumors relatively soon reach a stage where the cerebrospinal fluid block becomes complete in spite of a decompression and radiation and some form of extirpation may well be considered. It is believed that a rational and feasible approach to most of these tumors is through the dilated right lateral ventricle. Such was the approach in the following case.

W. McPh. SMH No. 27069, a woman aged 34 years was admitted to this hospital first on August 16, 1929, complaining of headache, failing vision, and bilateral tinnitus. The patient, who was the mother of four healthy children, stated that she had been perfectly well until the early part of 1929. At that time she began to complain of attacks of generalized headache and bilateral tinnitus. Shortly after this, vision began to fail. An ophthalmologist noted a bilateral choking of the discs and she was referred to the neurosurgical clinic of Dr. Cushing at the Peter Bent Brigham Hospital. Because of the lack of localizing symptoms and the presence of marked choked discs, a ventriculogram was done. The report of the films taken by Dr. M. C. Sosman follows: "Ventriculograms show definite dilation of both lateral and third ventricles but no displacement or deformity except for an irregular rounded mass about 2 by 3 centimeters in size, which projects upward and forward into the third ventricle from the region of the pineal. The tumor apparently occludes the aqueduct. Foramina of Monro are wide open and air passes freely between the ventricles. The findings are compatible with a tumor in the region of the pineal."

A right subtemporal decompression was done June 25, 1929, by Dr. Horrax. This was followed by a series of 7 deep therapy X-ray treatments instituted at the Brigham Hospital and continued in this clinic in August, 1929. At this time the choking of the discs had receded until they were nearly normal. Vision also had returned nearly to normal (20–30) and remained so for 5 to 6 months after the original operation. The decompression wound then began to become more tense and the discs slowly to elevate. Headache and an occasional attack of vomiting recurred.

She was readmitted to this hospital on March 5, 1930. Physical examination revealed little aside from a bilateral choking of the discs of 2–3 diopters with moderate secondary atrophy, a tense right subtemporal decompression area, absent abdominal reflexes, and a questionable difference in ankle jerks. The clinical laboratory findings were all within normal limits. Basal metabolism reading was –6, urine of normal specific gravity as well as free from sugar and albumin.

The ventriculogram was repeated. It showed essentially the same features as those recorded at the Brigham

Hospital, i.e., a mass projecting into the shadow of the air filled third ventricle. The size of the mass seemed about 1 centimeter larger in diameter than on previous ventriculogram films. There was no difference in the fluid removed from the two ventricles. The cell count, serology and chemistry in each was normal.

Operation—first stage. On March 13, a right parieto-occipital bone flap was turned down under novocain and ether anæsthesia. The ventricles were tapped daily to relieve symptoms of intracranial pressure.

Operation—second stage. On March 20, 1930, under local and ether anæsthesia, the wound was reopened. Inspection of the cortex revealed nothing of note except flattened convolutions. A reversed L shaped incision 6 to 7 centimeters long was made in the cortex extending from the posterior end of the superior temporal lobe gyrus upward and slightly backward ending at the lobulus parietalis superioris (Fig. 1). With the aid of the electrocautery the incision was carried downward into the ventricle without difficulty. The point of entering the ventricle was at the juncture of the temporal and occipital horns with the lateral ventricle (Fig. 2). Wet cotton pledgets were placed in the opening of the ventricles to prevent blood or tumor débris gravitating into them. A cotton pledget was placed over the exposed choroid plexus to prevent injury. This proved to have been ill advised, as considerable bleeding was encountered in separating the cotton from the meshes of the plexus at the end of the operation. A distinct bluish bulge was to be made out in the depth of the wound. This was covered by the much thinned out medial wall of the lateral ventricle and was easily divided and removed with the electrocautery. The third ventricle was opened anterior to the tumor. The tumor lay between and above the large dilated venæ vorticosæ (Fig. 3). It proved to be about 3 to 3.5 centimeters in diameter, was grayish red in color, soft, smooth in outline and apparently not actually invading brain tissue at any point seen. "Seeding" of the tumor in the lateral or third ventricle was not to be made out. At its base, however, it was adherent to the tributaries of the vein of Galen. The surface of the tumor exposed was coagulated with the electrocautery and the desiccated portion removed with suitable rongeurs and with the help of a suction apparatus. By repeating this process several times, the tumor was entirely removed except for a small bit adherent to the large adjoining veins. This was left inasmuch as the danger of uncontrollable bleeding from them was considerable. The wound was left perfectly dry and was closed without drainage.

Postoperative course. The patient did well immediately following operation except for a persistent Biot type of respiration which persisted for some 24 to 36 hours and a weakness of the left side. Some 48 hours after operation she became semicomatose and the wound was opened enough to insert a drain into the incision in the cortex. The patient's condition improved rapidly with the evacuation of blood tinged cerebrospinal fluid and a small amount of tissue débris. Within 12 hours she was again conscious. The drain was removed in 48 hours. The temperature following operation was elevated to 39–40 degrees C. for 5 to 6 days and then fell to normal. A left sided weakness cleared up in about 1 week and strength on the two sides has remained normal up to date. A left homonymous hemianopsia was noted before discharge from the hospital and has persisted. The decompression has remained very soft or at times sunken in. The discs are flat and show only moderate secondary atrophy. Deep reflexes are equal on the two sides and hyperactive. There is a slight hypoæsthesia to pin prick over the left side and from time to time an astereognosis on the left for test objects. This, however, is not enough to interfere with using the hand for ordinary housework.

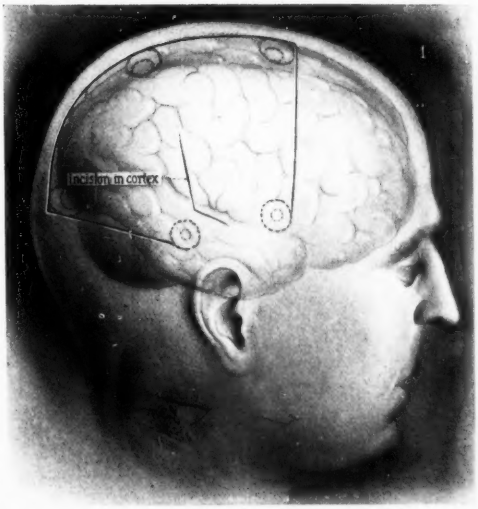

Fig. 1. Reconstructed drawing to show site and extent of incision in cortex—right side.

There has not been any postoperative diabetes insipidus. Sleep disorders have been irregular and insomnia rather than somnolence has been the complaint. Menses were absent for some 5 to 6 months after operation but have returned to normal. A basal metabolism reading 1 month after operation was −20.

From a mental point of view she has been somewhat slower in returning to normal than anticipated. Incontinence of urine and fæces were irregularly present for 2 to 3 weeks after operation. Where formerly she had been a very active, almost hypomanic type of individual, she has had a period of 2 to 3 months of moderate depression. This, however, has largely cleared up. Memory is good for remote events but on occasion moderately impaired for details of every day happenings. Ability to concentrate, calculate, and plan are moderately good. She is able to do a good part of the housework for the family of six people and in general the patient seems to her family and friends as mentally competent and an average normal.

Two deep therapy X-ray treatments have been given following operation inasmuch as a small fragment of tumor is known to have been left attached to large veins near its point of attachment.

Pathological examination. The fragments of tumor were placed in Zenker's fixer and stained with hematoxylin and eosin and Mallory's phosphotungstic acid hematoxylin stain. Other fragments were placed in a 10 per cent solution of formaldehyde. None of the fragments desiccated by the electrocautery were saved. Sections were stained with Mallory's phosphotungstic acid hematoxylin stain. The tumor proved to be of the spongioblastic type. Cells were grouped together in clusters and cords with strands of delicate connective tissue running between them, supporting thin walled veins and capillaries. The cells have a heavily staining round nucleus and a fairly abundant, pale staining granular cytoplasm. Mitoses are not seen.

The surgical approach for removal of tumors of the pineal gland through the right lateral ventricle

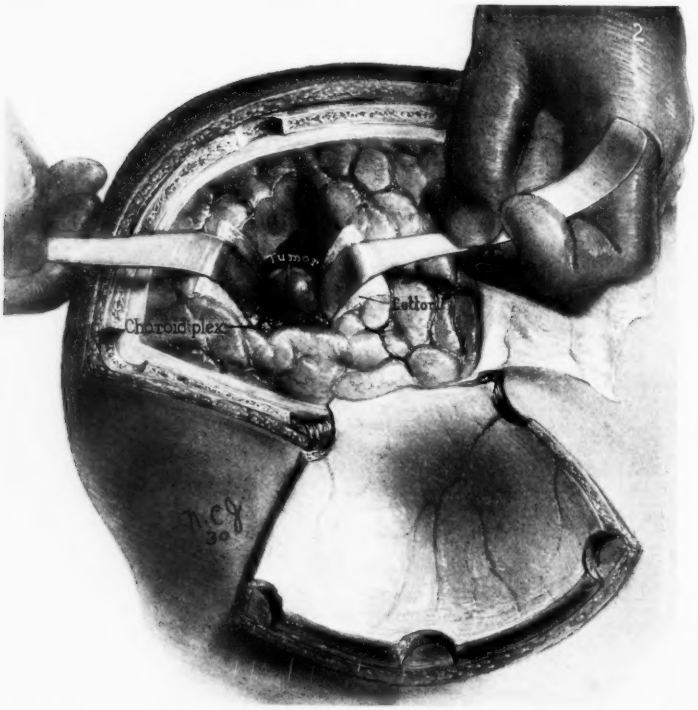

Fig. 2. Exposure of tumor after entering right lateral ventricle and removing medial wall of ventricle over tumor.

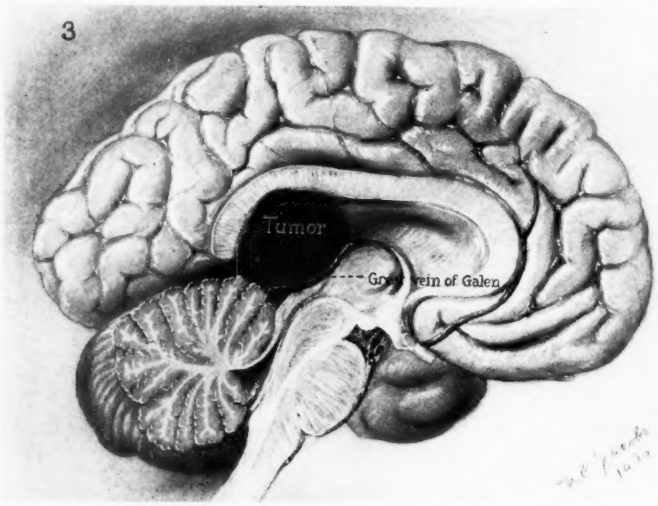

Fig. 3. Sagittal section to show relation of tumor to third and lateral ventricles and aqueduct of Sylvius.

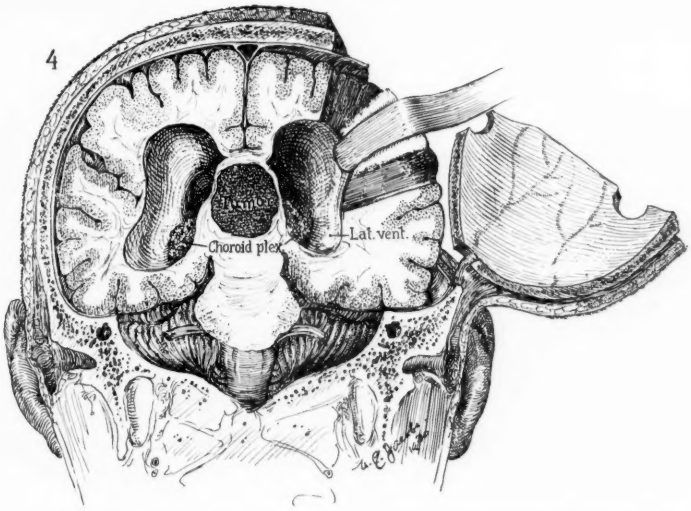

Fig. 4. Frontal section to show relationship of tumor to corpus callosum and also lateral ventricles.

is believed to be the logical one for most pineal gland tumors; without much doubt, it is the least vascular route. The only vessels of consequence that must be ligated before the tumor is exposed are the cortical veins which should offer little difficulty. The tributaries of the great vein of Galen about the tumor can be more easily seen and dealt with in an approach from the side inasmuch as such an approach is directly down on them. Removal of the tumor *in toto* is probably in most instances impractical and inadvisable since it may be more safely rongeured away or aspirated after being desiccated with the electrocautery. The amount of injury to brain tissue from an incision of the cortex can be no greater than the softening resulting from ligation of veins entering the lateral sinus which must be done in exposing the third ventricle through the corpus callosum.

An approach to the region of the third ventricle by dividing one lateral sinus and splitting the tentorium of the cerebellum has little to commend it. The approach is directly through many of the large engorged tributaries of the vein of Galen which are difficult to ligate or control and may lead to still greater hydrocephalus and large areas of cerebral softening if ligated.

The contention that the majority of pineal tumors tend to grow posteriorly rather than anteriorly in the inferior colliculi is not borne out by a review of the collected cases and can not be used as an argument for approaching these tumors from the posterior fossa or through a divided tentorium. Eighty-one case records have been found in the literature of pineal tumors the location and limitations of which were given exactly. Sixty-two of these tumors did not extend beyond the limits of the third ventricle. "Seeding"

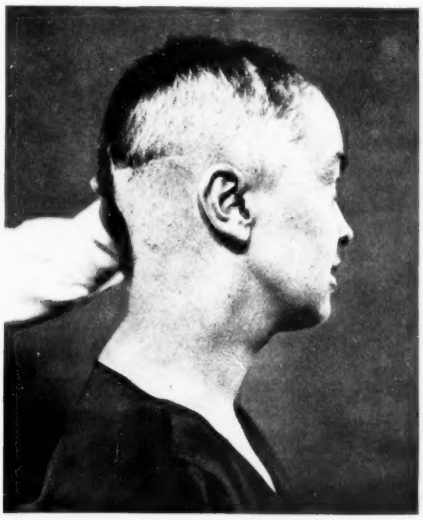

Fig. 5. Postoperative photograph to show site of craniotomy incision and former decompression wound.

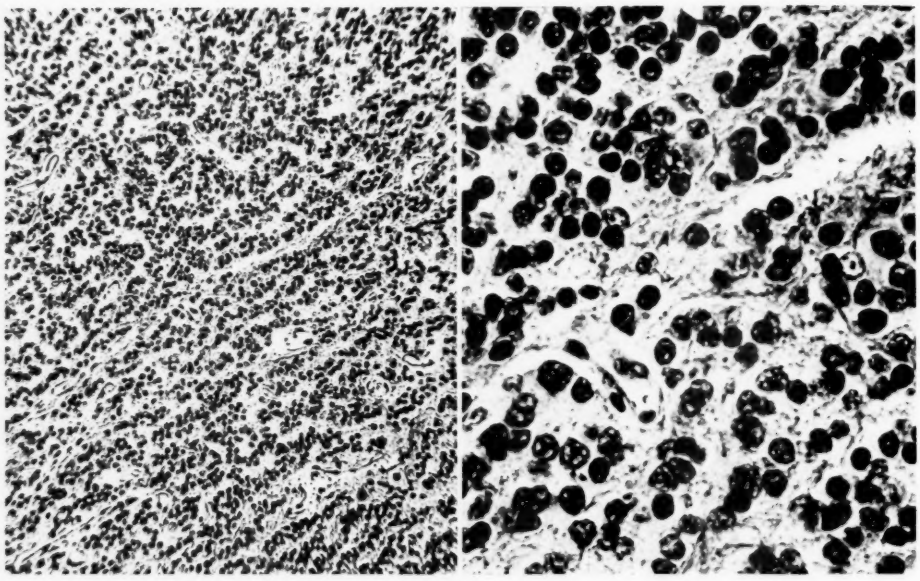

Fig. 6. Section of tumor—Mallory's phosphotungstic acid hæmatoxylin stain × 140 and × 610.

in the wall of the ventricles in some instances had given rise to multiple tumors. Fifteen extended both into the third ventricle and posteriorly into the Sylvian aqueduct and the region of the superior vermis of the cerebellum. Four were entirely outside of the limits of the third ventricle, either in the posterior fossa or in embedded brain tissue.

SUMMARY

The procedure of choice in dealing with tumors of the pineal gland would seem to be first to perform a right subtemporal decompression. This should be followed by intensive deep therapy X-ray or radium radiation until the combination of these measures no longer seem adequate to alleviate pressure symptoms. At this time an attempt at extirpation of the tumor might well be made. An approach of election would seem to be one through the dilated right lateral ventricle.

A case is reported of a successful extirpation of a pineal gland tumor (spongioblastic type) by this means in a 34 year old woman. She has remained entirely free from symptoms of hydrocephalus for 15 months following operation.

NOTE.—I wish to express my thanks to Dr. Harvey Cushing who kindly referred the patient to this clinic for observation following discharge at the Peter Bent Brigham Hospital.

SYPHILIS OF THE INTESTINE

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IN discussing syphilis of the stomach, Hartwell has stated that "a clear-cut distinction must be made between lesions of this organ caused by the spirichæta pallida and lesions which arise from other causes in a person suffering from syphilis. The first is a true syphilitic lesion of the stomach, the latter is not and must not be confused with the first.

In the present discussion the term syphilis of the stomach is used to indicate a lesion which shows pathological changes similar to those in other tissues caused by the luetic virus. This definition, in our opinion, applies not only to syphilis of the stomach but to syphilis of the intestine as well and represents the scientific conception of syphilitic lesions of the gastro-intestinal tract.

Syphilis of the intestine was first described by Monteggia of Milan in 1794 and later by Cullerier in 1854. Warstat in 1913 and Gaucher in 1916 have written extensive articles on congenital intestinal syphilis, while Ceraulo, Campana, and Schmidt have also written on syphilitic lesions of the intestines, both on congenital and acquired forms. The different phases of the disease have been thoroughly discussed and illustrated with case reports in these articles, from the slight enteritic manifestation to the less frequent obstructive lesions associated with encircling ulcers and the tendency to stricture formation.

Oberndorfer states that the gastro-intestinal tract is infrequently the seat of syphilitic lesions, usually gummatous neoplasms.

Brown and Gaither believe that congenital forms of intestinal syphilis obviously occur in early childhood, while syphilitic intestinal lesions of acquired syphilis are tertiary and late manifestations of the disease.

McCallum says "tertiary lesions of the small intestine are usually localized in the jejunum, or the upper ileum, where they appear as flat elevations of the character of a syphilitic granulation tissue involving submucosa and mucosa. Multiple ulcers are found which extend in the form of rings around the gut, and which in healing may produce strictures." He cites a remarkable example in the Pathological Museum of Colombia University, but says "the condition must be very rare."

Fraenkel, according to Wile, states that he has found only 3 cases of intestinal syphilis in 19,000 postmortem examinations. He says that in his 5 years' experience with luetic patients he has seen no such cases, and adds that the jejunum is the more frequent seat of the lesion than any other portion of the intestinal tract.

Sparman remarks that syphilis of the gastro-intestinal tract has no characteristic features, unless probably nocturnal exacerbations, and calls our attention to the comparative frequency in which cases of supposed malignant disease of the digestive tract have improved under anti-luetic treatment.

PATHOLOGY

There are no gross characteristics, although Gutmann in reporting a case of multiple ulcers of small intestines of syphilitic origin, describes them as circular, entirely enclosing the lumen of the bowel, with flat basis, sharp edges, and somewhat undermined. Rieder, as quoted by Gutmann gives the following characteristics:

1. The lesions may be situated in any part of the small intestine, but are especially frequent in the jejunum.
2. The lesions may be multiple or in separate groups.
3. The lesions have a tendency to encircle the lumen of the bowel.
4. The lesions may cause stenosis.
5. The lesions show uniform consistency.
6. The lesions have nothing to do with the primary ulceration but are a new tissue formation which attacks all the intestinal layers, localizing at any early stage around the blood vessels.

Microscopically the principal characteristics are "round cell infiltration with epithelioid cells and occasional giant cells. The blood vessels show endarteritis and endophlebitis obliterans sometime being completely occluded, and there is a perivascular infiltration. Miliary gummata are often seen."

The diagnosis of syphilis of the small intestine is obviously very difficult, as the symptoms are not characteristic but vary with the type and location of the lesion. Also, as already stated, intestinal symptoms in a person suffering from syphilis do not invariably mean that he has a luetic lesion of the small intestine. Perhaps the most important point to bear in mind in considering a diagnosis of intestinal syphilis is that obstructive symptoms in patients past middle life do

Fig. 1. Section of much thickened jejunum showing superficial and deep ulcerations and in the right half one large and one small gumma.

Fig. 2. From another section showing part of same lesion under high power. Beneath the mucosa are numerous giant cells and still lower down the upper part of the large gumma.

not necessarily mean cancer, in spite of a repeated negative Wassermann. From the surgical standpoint I am going to quote from Riggs who has summarized the subject very satisfactorily.

"In considering the field of surgery in syphilis of the intestinal tract one appreciates Wilmoth's classification according to symptoms, the order of which I am taking the liberty to reverse, believing that by so doing the order of clinical frequency is best represented.

1. Those with nausea, vomiting, and diarrhœa.
2. Those with definite digestive disturbances, associated with pain and distress.
3. Those indicating ulcer or stenosis.
4. Those simulating carcinoma, with palpable tumor.

It is evident that surgery is rarely if ever necessary or justifiable in the first group, but that with each succeeding group its opportunities for good increase, especially if co-ordinated with correct diagnosis and proper treatment.

CASE REPORT

J. A. H., Cuban, 38 years of age, barber by occupation, was first admitted to this hospital on June 14, 1927, with a history of gastro-intestinal disturbances characterized by flatulence, anorexia, and constipation. These symptoms had been present for the past 2 months, becoming gradually worse until 2 days previous to admission, when he was seized by an excruciating pain over the epigastric region, radiating to back and right shoulder, and associated with nausea and vomiting. Jaundice pruritus and clay stools followed the attack. The family history was irrelevant.

Physical examination showed a fairly well developed adult male, poorly nourished, with conjunctiva and skin deeply jaundiced, marked tenderness and rigidity on pressure over the right upper quadrant where a mass could be

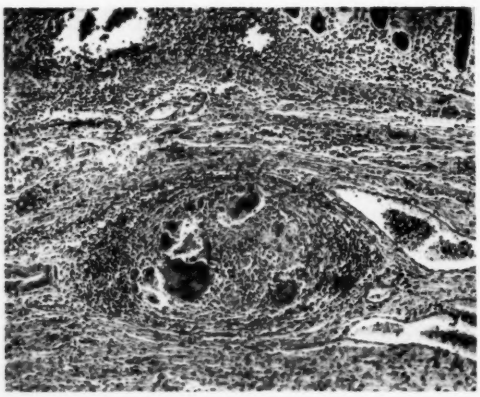

Fig. 3. A miliary lesion in the submucosa containing several giant cells.

Fig. 4. A larger lesion in the submucosa with the base of an ulcer on the right. Numerous giant cells present and also beginning necrosis.

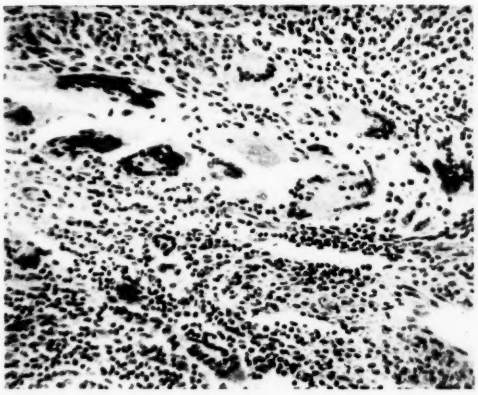

Fig. 5. Many giant cells under high power. They appear in the submucosa of Figures 1 and 2.

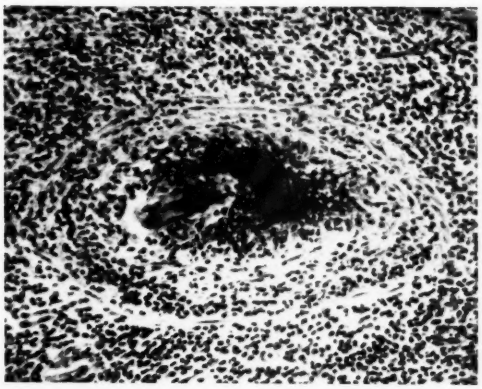

Fig. 6. A similar lesion in another blood vessel. A large giant cell present.

palpated. The other organs were negative. The leucocyte count was 25,000; polymorphonuclears, 75 per cent. Urine was positive for bile and showed a slight trace of albumin.

The patient who was on the medical service showed gradual improvement under treatment. I saw him for the first time on July 25, 1927, a month and 11 days after admission, when, based on the history, the provisional diagnosis of cholelithiasis was made and operation advised.

Operation. Spinal anæsthesia was used and the abdomen was opened through a Judd oblique incision. The stomach and duodenum were found to be negative. The gall bladder was slightly distended, somewhat thicker than normal, could be emptied easily on pressure, and showed no stones. The cystic and common duct were negative. The head of the pancreas was definitely enlarged, markedly indurated, and was encroaching upon ducts and duodenum. The diagnosis, in our opinion, lay between a chronic pancreatitis and a malignant condition, and a section of the tumor was excised for pathological examination. The abdomen was closed without drainage and the patient was kept in the hospital until August 12, when he was discharged free of jaundice and feeling much improved. The diagnosis of Dr. Mallory then was chronic pancreatitis.

The patient was readmitted to the hospital June 13, 1928, almost a year after his first admission, with the following history:

From January of this year he began to suffer from gastrointestinal disturbances, more or less similar to those experienced a year ago, but with the outstanding symptom of marked feeling of fullness in the stomach, even after a small intake of food. He also noticed a dull, more or less constant, pain in the epigastrium with colic-like exacerbations which were only relieved by vomiting, self-induced in many occasions. During the 5 days previous to admission he had become so weak that he had to be brought to the hospital by his attending physician. The vomitus had never shown any blood, but was always bile stained.

Physical examination at this time showed a poorly nourished, anæmic, markedly dehydrated adult male. No signs of jaundice were present. Heart sounds were distinct but rapid. Lungs were negative. The pulse rate was 120; respiration, 22; temperature, 98 degrees F.

The incision of previous operation was soundly healed. No signs of hernia were present. The abdomen was slightly distended. Pain and tenderness could be elicited by pressure over epigastric region. The stomach area was tympanitic.

In view of the critical condition of the patient, no further diagnostic procedure was tried, and with the history obtained a provisional diagnosis of upper intestinal obstruction with dilatation of the stomach was made, and the patient treated as follows: The stomach was thoroughly washed out with solution of sodium bicarbonate. It showed marked bile retention and very few particles of food.

One thousand cubic centimeters of 5 per cent saline glucose solution was given intravenously and 1,000 cubic centimeters of the same solution by hypodermoclysis. Murphy drip was instituted with 10 per cent glucose saline solution. Nothing was given by mouth. On August 16 and 17, the same treatment was given, the patient showing marked improvement.

On August 18, X-ray pictures were taken and the following was the radiologist's report:

"Stomach markedly dilated, showing practically complete retention, 6 and 12 hours after barium meal. Obstruction apparently present at duodenojejunal angle."

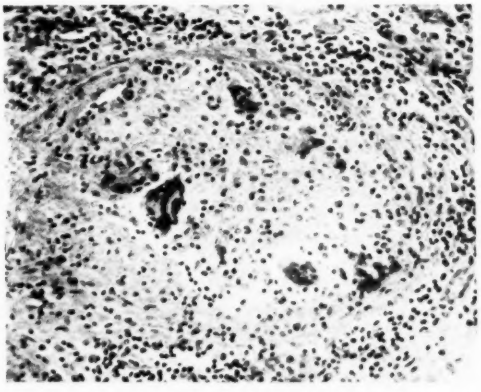

Fig. 7. Another lesion within a blood vessel showing several giant cells and no fibrin.

The stomach was immediately washed out and the treatment of previous days repeated. On August 20, an exploratory laparotomy was decided upon.

Operation. Local and spinal anæsthesia was supplemented with ether. A large midline incision was made from the xiphoid cartilage to a point about 1 inch to the right and below the umbilicus. Exploration revealed an indurated, irregularly outlined ulcer about 3 inches in length, involving almost the whole circumference of the small intestine and affecting the terminal end of the duodenum and the first part of the jejunum. It was densely adhered to the posterior wall of the transverse colon with many adhesions surrounding the whole inflammatory area. The diseased portion of the intestine was excised after a laborious dissection, and an end-to-end anastomosis was performed. While exploring the posterior wall of the stomach, we palpated a soft, pulsating tumor about the size of a small lemon, with an apparent thrill which we first thought to be an aneurism of the abdominal aorta, but on further exploration we found it to be a cyst of the pancreas, which was incised, the extra pancreatic portion of it being clipped away with scissors. A Penrose drain was put in and brought to the surface through the gastrohepatic omentum. The gall bladder showed many adhesions and contained several calculi. A cholecystectomy then, in our judgment, was a too radical procedure that would increase the shock produced by the already lengthy operation, so we limited ourselves to draining the gall bladder after we had removed 13 small stones. The stones were soft, of the cholesterol type, and apparently of recent formation. They were not present a year before. The appendix was also removed.

The patient made an uneventful recovery and left the hospital in good condition. The Meinicke reaction for syphilis, after provocative treatment, became slightly positive. He received strong antisyphilitic treatment during his convalescence, and was advised to return for another course of potassium iodide and bismuth.

The histopathological diagnosis of Dr. F. B. Mallory of Boston to whom the specimen was sent was syphilis of the intestine (see photomicrographs).

SUMMARY

A case is reported of syphilitic ulcer of the small intestine. The diagnosis was confirmed histopathologically by Dr. F. B. Mallory. There was in addition a cyst of the pancreas and cholelithiasis. Surgical treatment resulted in complete recovery.

Syphilis of the small intestine is a rare condition. Fraenkel found 3 cases in 19,000 autopsies. Chiari found 8 cases of gastro-intestinal syphilis in 243 syphilitic corpses. Mallory has seen 2 cases in his life time. McCallum cites a remarkable example in the Pathological Museum of Colombia University, but says "the condition must be very rare."

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RE-ESTABLISHING THE FLOW OF BILE INTO THE INTESTINAL TRACT

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IN 1881, the same year that Billroth made the first resection of the pylorus, his former pupil, von Winiwarter, completed the last stage of an operation to re-establish the flow of bile into the intestinal tract after its normal course had been stopped by an obstruction in the common bile duct.

Since von Winiwarter's day a wide variety of conditions which have prevented the flow of bile into the intestine has been observed and recorded. Some of these recorded conditions are congenital atresia of a bile duct; malignant stricture; cicatricial contraction and stricture of a bile duct following healing in obliterative cholangitis, simple ulcer, gall-stone ulceration, or damage done to a duct wall by a rubber drainage tube; obstruction of a bile duct caused by a stone or an intrinsic tumor; obstruction produced by pressure on a bile duct from an extrinsic tumor, an inflammatory swelling of a neighboring structure, or adhesions; traumatic perforation or rupture; and operative trauma such as the accidental division or resection of a bile duct, the ligation or the crushing of a duct, or the excision of a bit of the duct wall.

Many operative methods have been devised to re-establish the flow of bile into the intestine when its natural flow has been arrested by one of these conditions. Von Winiwarter, in 1881, performed a cholecysto-enterostomy. He found when operating upon a patient that an obstruction in the common bile duct had blocked the normal passage of bile. After several attempts he succeeded in forming an anastomosis between the gall bladder and the jejunum. Ten years later, in 1891, Sprengel made the first report of a communication established between a bile duct and the intestine. Sprengel, in an operation to relieve a patient of gall-stone colic, removed the gall bladder and crushed a stone which had lodged at the portal fissure. Bile immediately distended the common bile duct and began seeping through the newly sectioned stump of the cystic duct. To avoid the possibility of an external biliary fistula forming, Sprengel made an incision in the wall of the common bile duct which he sutured to an incision in the duodenum. Bile flowed into the intestine. Riedel, in 1888, performed the same operation of direct lateral choledochoduodenostomy, but he did not report it until 1892. The earliest recorded case of direct hepaticoduodenostomy was performed by W. J. Mayo in 1904 and reported by him in 1905. When he found the lumen of a common bile duct entirely obliterated he divided the hepatic duct above the obliteration and implanted the stump of the bile duct into an incision in the duodenum. This method of delivering the bile into the intestine proved most satisfactory. The patient on whom the operation was performed lived in good health for many years. W. J. Mayo has perfected the technique of the hepaticoduodenostomy and used it many times with successful results. It has become the method most frequently and satisfactorily employed. In 1905, the same year that W. J. Mayo reported his hepaticoduodenostomy, Kehr (4), in his book, "Technik der Gallensteinoperationen," recorded a case in which he had performed the same operation in 1902. In 1909, and again in 1912, Sullivan published the results of his experiments on dogs which proved the possibility of epithelization taking place along a canal formed over a rubber drainage tube when the tube bridged a gap between the severed end of a bile duct and an opening in the duodenum and when the exposed portion of the tube was covered over with omentum. Sullivan's work established the indirect method of union in bile-duct surgery.

The direct end-to-end anastomosis of a divided bile duct was first performed by Doyen in 1892. After he had torn a common bile duct transversely when removing a large stone, Doyen united the two ends of the bile duct by circular suture around a short length of rubber drainage tube. Doyen's patient died of hepatic insufficiency a few hours after the operation. This was before healing could take place and before the end-result of such an anastomosis could be noted. The direct end-to-end anastomosis has since been used successfully in numerous instances, the anastomosis usually being made over a rubber catheter or a rubber T-tube. An indirect end-to-end anastomosis was made by Verhoogen in 1907. In order to remove a tumor he excised a portion of the hepatic and common bile ducts. As the patient's condition demanded a quick completion of the operation, Verhoogen made a communication between the bile-duct ends by means of a rubber drainage tube. He reported his patient well 3 months after the operation. Indirect end-to-end anastomosis of a bile duct has occasionally been

employed by others but not always with good results.

The earliest attempt to implant a biliary fistula into the gastro-intestinal tract was undoubtedly made by Czerny (Merk, 8) in 1898. He attempted to relieve a patient of biliary obstruction caused by a carcinoma of the common bile duct near the papilla. Implantation of the fistula did not restore the flow of bile as there was an obstructing metastasis in the hepatic duct. Even though the implanted fistula did not, in this instance, deliver bile into the intestine, Czerny conceived both the idea of implanting a biliary fistula and the technique for carrying out such a procedure. Williams, in 1913, was the first one in America to implant a biliary fistula into the intestine. His operation, which gave entirely successful results, was reported in 1923 by Lahey, who at the same time reported an implantation which he himself had made. No large series of operations by this method has been reported. Walters, in a personal communication, stated that he has implanted a biliary fistula into the stomach or intestine in 5 different cases. In 4 of the 5 cases the functional results were good.

In a few cases when no other procedure was practicable, a hepatocholangioenterostomy has been made by incising the liver and the intestine and anastomosing the two openings in order to get a direct flow of bile from the liver into the intestine. Kehr used this method in 1904. When he found the extrahepatic biliary tract indurated and its lumen obliterated, he cut an elliptically shaped piece 6 centimeters long and 2 centimeters broad out of the liver and deepened the hole with a cautery. He then anastomosed the edges of this opening to an opening made in the duodenum. This procedure was done with the idea of making a fistulous communication between the liver and the duodenum in order to have a channel for conveying the bile. Only 4 cases have been recorded in which bile flowed into the intestine following a hepatocholangioenterostomy. In each case the lumen of the bile ducts was considered to be obliterated. But in at least 2 of these cases there is a question of doubt as to whether the re-establishment of the flow of bile was due to the functioning of the fistulous communication between the liver and the intestine, or whether it was due to a re-opening of the lumen of the bile ducts.

Von Stubenrauch, in 1906, reported a plastic operation on the biliary tract in which reconstruction was accomplished by means of a pedicle flap. He formed a canal for the bile to flow into the gastro-intestinal tract by cutting a flap 6 centimeters long and 2 centimeters wide from the wall of the stomach, turning it backward 180 degrees, and suturing its end to an opening in the gall bladder. The new canal was functioning 6 months after the operation when the case was reported. A pedicle flap cut from the gastric or duodenal wall, or formed from the atrophied gall bladder or cystic duct, has been used in a few cases either to repair a defect in a bile-duct wall or to reconstruct the hepatic duct in order to make a hepaticoduodenostomy. Moynihan, in 1904, performed the earliest reported plastic operation on a bile duct made without the use of a pedicle flap. He incised a strictured bile duct longitudinally and sutured it transversely to enlarge its lumen. The patient was well 4 years after the operation. In the few reported cases of longitudinal incision and transverse suture the functional results have been excellent. Longitudinal incision and reconstruction over a rubber drainage tube is a method of plastic reconstruction which has been used in a considerable number of cases but rarely with permanently good results. By this method a strictured bile duct is incised longitudinally to enlarge its lumen, a rubber drainage tube is placed in the bile duct to maintain the increased caliber of the duct, and healing takes place across the gaping or partially sutured edges of the incision. Lejars performed an operation of this kind in 1908. While the immediate result was satisfactory, symptoms of obstructive jaundice later developed which necessitated a subsequent operation.

A strictured bile duct has in some cases been dilated sufficiently to re-establish the flow of bile. Parkes, in 1885, dilated a strictured common bile duct by means of a steel sound which he introduced through a fistulous opening in the gall bladder. Kehr (Volkmar, 17), in 1908, succeeded in dilating a contracted portion of a common bile duct by means of a laminaria tent. The following year in another case, he (Eichmeyer, 2) used a pair of dressing forceps to dilate a stricture in a common bile duct. Since then forceps have been employed for strictures in various parts of the common bile duct including that portion which passes through the head of the pancreas. They have also been used to dilate strictures of the sphincter of Oddi.

There are many different adaptations of these operations. In general, however, all the methods which have been used to re-establish the continuity of the biliary tract with the intestinal tract can be grouped as follows:

I. The implantation of a portion of the biliary tract into the alimentary tract.
   a. Direct implantation of the biliary tract.
   b. Indirect implantation of the biliary tract.

II. The end-to-end anastomosis of a divided bile duct.
   a. Direct anastomosis of a divided bile duct.
   b. Indirect anastomosis of a divided bile duct.
III. The implantation of a biliary fistula into the alimentary tract.
   a. Direct implantation of a biliary fistula.
   b. Indirect implantation of a biliary fistula.
IV. The establishment of a direct communication between the parenchyma of the liver and the alimentary tract (hepatocholangio-enterostomy).
V. The plastic reconstruction of a portion of the biliary tract.
   a. Plastic reconstruction with the use of a pedicle flap or of a transplanted graft.
   b. Plastic reconstruction without the use of a pedicle flap or of a transplanted graft.
VI. The dilatation of a strictured bile duct.

An exhaustive review of the recorded cases in which operation was made to re-establish the flow of bile, indicates that the principles which have been definitely established are that the reconstructed tract must become lined with epithelium and that it must not contract later to form a stricture. These essentials are best obtained by a simple muco-mucous union of the biliary tract with the gastro-intestinal tract. Such a union was made in the hepaticoduodenostomy performed by W. J. Mayo in 1904 and used by him many times since. In his writings he has stressed the importance of the muco-mucous union.

The one operation in which a union of the mucous membranes has in many instances failed, has been in a direct end-to-end anastomosis of a common bile duct. These failures have not resulted from the muco-mucous union which was made but from too much tension being exerted on the tissues when the sutures were pulled tightly in order to approximate the ends of the bile duct. No doubt in these cases so large a segment of the duct was removed that an end-to-end anastomosis should not have been attempted. In some cases in which an end-to-end anastomosis has failed, a hepaticoduodenostomy has later brought successful results. The reason for the success of a hepaticoduodenostomy is that the duodenum can usually be mobilized and united to the stump of the hepatic duct without tension. In numerous instances in which the duodenum could not be sufficiently mobilized, the union has been made with the stomach because of its close anatomical relation with the hepatic duct.

Fig. 1. The L-shaped rubber catheter for draining the bile ducts. The short, fenestrated portion of the tube is designed to lie within the bile duct. The eye at the elbow and the one at the tip of the catheter provide a means of internal drainage of bile when the lumen of the bile duct is unobstructed. The four lateral eyes insure external drainage if the bile duct becomes obstructed.

The lumen of the reconstructed tract must in most instances be kept open by a rubber drainage tube or by some other device until union and the epithelization of the canal has taken place. The use of a small segment of a rubber drainage tube or catheter which is covered over and allowed to remain in the bile duct is not advisable. If it is not passed from the duct it will become encrusted with bile salts and obstruct the lumen of the duct, or it will disintegrate and the small particles of rubber will become nuclei for stones which will eventually obstruct the duct. There is one word of caution that should be kept in mind if a T-tube is used for this purpose; that is, it must be left in position for months, as Judd has suggested. Its too early removal has sometimes torn the bile duct and the healing of the tear has resulted in the formation of a stricture. In cases in which a removable drainage tube is desirable I advise the use of a removable L-shaped rubber catheter.

The L-shaped catheter is of flexible rubber molded with 2 inches of the tip bent at a right angle. Sizes 16 and 18 Fr. are the ones most generally used. To provide adequate internal and external drainage of bile the catheter is made with six eyes in its short portion which is designed to lie within the bile duct. With an eye placed at the right-angle bend and another at the tip, bile can flow through freely so that internal drainage can take place when the lumen of the bile duct is unobstructed. Four additional lateral eyes in the short portion of the tube insure external drainage if the lumen of the bile duct be obstructed. This L-shaped catheter can be used for drainage following choledochotomy, dilatation of a stricture of a bile duct, longitudinal incision and reconstruction of a bile duct, and end-to-end anastomosis. The L-shaped catheter can be so securely fastened in a bile duct that drainage can be maintained for many weeks if desired. A chromic catgut suture is used to close the bile-duct opening tightly about the tube. The suture is then knotted and the ends wrapped round the stem of the tube. To

secure the catheter further, a silkworm suture may be fastened to the skin and external sheath of the rectus muscle, and the ends of this suture may also be wrapped round the tube. Later, after the wound has healed, the catheter may be secured by strips of adhesive passing down opposite sides of the tube and outward on the surface of the skin. The L-shaped catheter can be removed easily without traumatizing the bile duct in any way. The small opening through which the catheter passed heals quickly (Fig. 1).

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THE SURGICAL TREATMENT OF CARCINOMA OF THE COLON[1]

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THE importance of malignancy of the colon as a public health problem is obvious when one recognizes that 10 per cent of all carcinomata which occur in the gastro-intestinal tract are in the large intestine or the rectum. Surgical procedures directed toward pathological conditions of the colon unquestionably in the past decade have reached a high plane of technical perfection. They have been put on a satisfactorily comparable basis with the maneuvers which are aimed at the resection or extirpation of other organs of the body.

Recently, surgery of the sympathetic nervous system has been directed toward the treatment of megacolon, obstinate constipation, and other diseases of the large bowel hitherto considered amenable only to either medical treatment or segmental resection. In the main, however, all technical maneuvers on the colon are directed toward elimination of malignancy or such inflammatory conditions as diverticulitis or hyperplastic tuberculosis.

With advancing interest in organic conditions of the large bowel and increasing facilities for diagnosis, particularly by roentgen-rays, the recognition of colonic malignancy has been so forwarded in recent years that in the hands of expert roentgenologists, at the present time, it is comparable to the accuracy with which gastric lesions were formerly diagnosed. Pathologically, embryologically, and clinically, one must recognize the large bowel as a bifunctional organ, harboring neoplasms of different types in the two segments, and demanding entirely different procedures for their extirpation. Fundamentally, one may not attack the right half of the colon by the same methods used in the left half, because of the vital differences incident to the function of the two sides and the variety of pathological growths observed.

Infection, obstruction, debilitation, lowered vitality, complications such as distant metastasis, local fixation, and formation of abscesses common to lesions of both sides of the colon in the more advanced stages, are influences, the successful combating of which has changed, in large measure, the entire scope and prognosis of surgery of the large bowel. At the same time diagnostic measures have been forwarded advantageously.

THE RELATION OF POLYPS TO FORMATION OF CARCINOMA

Etiologically, carcinoma continues to be as baffling as it formerly was, and carcinoma of the colon is no exception to this generalization. Yet, of considerable interest and not indefinite importance is the fact that the relationship of certain commonly found lesions of the large bowel and rectum, for instance polyps, to formation of carcinoma, apparently sheds some light on the cause in a group of cases that is perhaps considerably larger than is suspected. The histogenesis of carcinoma developing on the basis of polyps is a well recognized sequence, and in carcinoma of the colon one may trace with especial accuracy a sequence of events from polyps to malignancy in an unbroken chain. Although I would not advocate the thesis that all carcinomata of the colon or rectum develop on the basis of polyps, nevertheless, I believe it is easily proved that a large majority of them do. This hypothesis, intriguing as it is, is not impregnable, and although it may be argued with vibrant cogency, I question its universal acceptance in view of present day knowledge as to the origin of carcinoma, without better confirmation of the stimulating force through which carcinoma is initiated.

In The Mayo Clinic recently, in association with FitzGibbon, I traced a series of polyps in their change to carcinoma, in 13 cases of multiple polyp of the colon, 2 of which were instances of generalized involvement of the whole lower bowel. In these 13 cases, there appeared 24 definite carcinomata. In 2 of the cases of polyp, carcinomata were not found. In the 11 remaining cases, there were 24 definite carcinomata, 21 of which appeared in 8 cases and one each in the 3 remaining cases. This demonstrates in this series the ratio of multiple to single centers of malignant change in polyp soil as 8:3. Moreover, this work confirmed in detail the reports of Hauser, Wechselmann, and, later, of Schmieden and brought the total number of instances in the literature in which the direct sequence has been established to 140.

The term "precancerous tissue" is always a questionable one to use because carcinomata are, relatively speaking, never seen except in their fullgrown form. In the lower portion of the colon and in the rectum, where carcinoma occurs eight

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times as frequently as it does throughout the balance of the structure, one is able to study earlier deviations from normal tissue, because of the accessibility of the region. In addition, the presence of large and, frequently, multiple polyps in this situation offers numerous opportunities to aid in the search for degenerative histological changes. It has long been an established fact that when multiple polyps are scattered throughout the large bowel under different designations, such as diffuse polyposis or adenomatosis, malignant degenerative changes occur in practically 40 of every 100 cases. The familial tendency to the development of this so-called polyposis or adenomatosis is well established, and in the records of the clinic we have instances of two families, in each of which 5 cases of the disease have been established beyond peradventure. Considering for a moment, then, multiple polyposis from an etiological standpoint, the classification of the causative factors varies much, according to the view or angle of attack of the observer. Not infrequently, from the clinical standpoint, dysentery, ulcerative colitis, hyperplastic tuberculosis, and non-inflammatory reactions of the large bowel are mentioned as predisposing and exciting causes, making easy a grouping along two lines: (1) the adult or acquired type, and (2) the adolescent, congenital type. In demonstrating the degeneration of polyps into malignant growths, the classification on the basis of their histological structure is a more logical one, which I think in a large number of cases, unquestionably proves polyps to be precursors of carcinoma.

In our study of the 13 cases of multiple polyps of the large bowel, to establish histological criteria the cases were divided into three groups and the review of the characteristics of polyps demonstrated that they were not all of a piece and that under the name were included precancerous changes through which could be traced definite carcinoma. In group 1 were included only those polyps in which the epithelium retained its normal characteristics. The tumefactions were smooth and regular, or roughly nodular in some cases, and varied in size from tiny protuberances to masses 2 centimeters or more in diameter on cross section. The matrix of the stalk was the loose connective tissue of the submucosa which expanded to sustain the nodular polyp; there was no tendency to branching or papillary forms. The outstanding characteristic of this group was that there was no indication that the polyps were likely to be affected by whatever stimulus initiates carcinomatous change and that they might be considered benign. In group 2, however, the polyps were sharply distinguishable from those of group 1 by their structural changes in both connective tissue and epithelial elements, and were distinctly malignant. Throughout the polyp there was failure to differentiate into the units of normal intestinal mucosa. In the partially differentiated epithelium, the cells were elongated and compressed from side to side. Although they might be arranged in single rows, in numerous places the compression had piled them into overgrowths of buds which projected into the lumens of the tubules. Likewise, the nuclei were elongated. They took stains deeply, and this gave to the tissue of proliferation a darker color. FitzGibbon urged that the tempo of the growth is the essential function in the development of malignant polyps. In this group, as the epithelial proliferation proceeded, there was a response in the connective tissue elements, resulting in the piling up of the muscular layer, and the submucous layer as well, into a stalk. If the tempo was not too brisk, these elements were drawn out into branching divisions, making tree-like supporting scaffolds of epithelium. The formation of the pedicle was a matter of epithelial growth in the connective tissue. Sluggishly growing polyps might be greatly influenced by factors outside the tumor, particularly by the forces of peristaltic action.

The polyps of group 3 were potentially deep-seated, infiltrating carcinomata. In this group were placed those polyps in the epithelium of which the differentiation had stopped so early that the cells were rudimentary and embryonal in type. Group 3 was but a further progression of group 2. Microscopically, however, the two groups were readily distinguishable. In group 3 the epithelial proliferation was so rapid that the connective tissue was outdistanced and the polyp form consisted of epithelium and tangled skeins of gland tubules. These polyps necessarily, because of these histological characteristics, were not bulky or sizeable, and from them might be traced, through their rapid proliferation, large ruptures through the muscularis mucosa, which would become deep-seated, infiltrating, rapidly-growing adenocarcinomata.

These data, although not conclusive because of the meager number of cases studied, are indubitably confirmatory and stimulating in the search for the initiatory factor which forces the tissue cell into abnormal activity, resulting in malignant degenerative changes.

DIAGNOSIS

The diagnosis of lesions of the large bowel is made by a painstaking anamnesis supplemented

by careful physical examination and corroborated by roentgenoscopy (Figs. 1 to 7). Since it is impossible to correlate the symptoms and signs of the entire colon as a single organ, because of the differences in its two halves, two parts should be considered as separate and distinct organs for the particular purpose in hand. The right half of the colon, to the middle of the transverse segment, develops with and parallels functionally the portion of the small bowel which is distal to the papilla of Vater; that is, its function is absorptive and symptoms referable to it are indicated by disturbances of physiologic function. The left half of the large bowel, which develops with the rectum from the hindgut, is a storehouse, absorbing, perhaps, less than 10 per cent of the fluid content of the gastro-intestinal tract and symptoms referable to it revolve around obstructive phenomena.

A number of outstanding conditions influence the production of symptoms in the right half of the colon; namely (1) the liquid content of this segment; (2) the types of pathological growths in this portion, which are flat, large, ulcerating, are covered with stubby, grayish protuberances, and are inclined to occupy the lateral wall of the bowel, without producing obstruction; and (3) the anatomic consideration of the size of the bowel which here is twice that of its fellow of the opposite side, with thinner musculature. On the basis of symptomatology, cases of carcinoma of the right half of the colon may be divided into three distinct groups which should be considered separately: (1) the dyspeptic group, usually diagnosed chronic appendicitis or "intestinal indigestion"; (2) the group characterized by anæmia and weakness of unexplained origin; and (3) the group in which the tumefaction is frequently discovered accidentally or in the course of a routine examination, without having previously produced symptoms.

Group 1, or the dyspeptic group, represents a large number of cases, which, because of the very uncertainty and indefiniteness of the clinical manifestations, frequently is far advanced on being presented for examination. Because of this particular group, I would emphasize especially the fact that carcinomata of the whole colon, in their earlier stages, in probably more than 90 per cent of the cases, have few pathognomonic symptoms and frequently are evidenced by change of intestinal habit, or by intestinal irregularity such as mucous diarrhœa or alternating periods of diarrhœa and constipation. The obvious corollary to this is that one should make a thorough investigation of the gastro-intestinal tract if change of intestinal habit or intestinal irregularity persists over a period of, say, one month. In these indefinite cases, pain and local tenderness over the cæcal area simulating the symptoms of subacute or chronic appendicitis, and without a tendency to disappear entirely, should call attention to the necessity of a gastro-intestinal examination, because frequently these may be the earliest symptoms to be found.

In the second group, characterized by weakness and by anæmia without visible loss of blood, without premonitory symptoms, one finds a considerable number of right colonic carcinomata. This anæmia is always unassociated with visible loss of blood and frequently is called to attention by attacks of unexplained weakness or inability to carry on work. The anæmia may be noted in the course of a routine examination. The exact explanation of this type of anæmia is not clear, but it seems definitely related to some perverted function of the mucous membrane of the large intestine, which is impaired to such extent that absorption of toxins results. Sometimes the concentration of hæmoglobin is as low as 25 or 30 per cent before the patient is forced to undergo a physical examination. Usually when such depletion of the blood has occurred, however, localizing signs are present, and the disease is readily diagnosed by the characteristic roentgenogram. So often does this picture of anæmia occur that I am of the opinion that no patient should receive a diagnosis of primary or secondary anæmia until a thorough examination of the entire colon has precluded the possibility of malignancy in its right half. It is axiomatic among clinicians that pernicious anæmia should always be differentiated from gastric malignancy, but I am confident from my own experience that more often it is necessary to exclude carcinoma of the right half of the colon. The differential diagnosis is in no wise difficult and may readily be made from the blood picture and the clinical findings.

The surprising number of silent carcinomata of the right half of the colon, and, likewise, the high percentage of those that are accidentally discovered is something to which I wish particularly to direct attention. In perhaps 10 per cent of cases seen at the clinic, either a tumor is discovered by the patient when he least suspects it, or, in the course of a routine examination for a few intestinal symptoms, roentgenologic examination will reveal a filling defect in the cæcum. I mention this group of cases because of its surprising number and to drive home the importance of a rigid examination by roentgenoscopy not only in cases in which a lesion of the large bowel is

suspected, but even as a part of the yearly health examination.

In the left half of the colon, obstructive phenomena dominate the clinical picture. There are obvious reasons for this: (1) pathological growths of this side of the large bowel are inclined to be of an encircling type, frequently incorporating the whole lumen of the bowel and causing progressive stenosis; (2) the fæcal content of the left half of the colon is hard and formed, and with difficulty can be forced through a closing segment. Clinical symptoms depend on the amount of obstruction present when symptoms manifest themselves to the patient. Obstruction is of two types, acute or chronic. There is a small group of persons, about 5 per cent of the whole, in whom obstruction comes on without premonitory symptoms and is acute and complete from the beginning. This group of cases presents the most difficult and trying experience a surgeon is confronted with, in that a potentially fatal, acute condition is superimposed on a progressively fatal, chronic one. In a group of persons in adult life, in whom acute intestinal obstruction is diagnosed, if one can by any means determine that the lesion is limited to the large bowel, and at the same time can exclude the possibility of strangulated hernia and intussusception, the chances are 90 per cent in favor of the lesion causing the stenosis being a carcinoma of the left half of the colon. Relief of this condition is urgently demanded and most frequently is best accomplished by blind cæcostomy, to be supplemented subsequently by direct attack on the carcinoma, after its localization has been made possible by improvement of the patient's condition and subsequent examinations. In the main, obstruction is present in the vast majority of cases of carcinoma of the left half of the large bowel in some form or other: acute, subacute, or chronic. The subacute and chronic varieties are progressive and manifest themselves either by increasing constipation in elderly persons, or by intestinal irregularity and change of intestinal habit. Moynihan's axiom is strikingly true; it reads as follows: "In left colonic growths, constipation is the rule, while in right colonic growths, constipation is rare." This may be supplemented by the aphorism of Rutherford Morrison: "Increasing constipation of recent origin in an elderly person, only overcome by purgatives, suggests malignant disease of the left half of the large bowel."

Borborygmus and visible peristalsis are frequently noted when the stenosis is progressive and is becoming complete. The borborygmus, associated with increased flatulence, may be accounted for by change in the intestinal content or may be due to degeneration of the tumor or to obstructive changes which accompany it. Visualization of peristaltic movement is possible only in lean persons or persons in whom the contraction of the lumen of the bowel produces such obstruction to the fæcal current and peristaltic wave as to produce proximal dilatation with increased stenosis. The effort of the bowel to force its content through an obstructed lumen may be observed more clearly, and occasionally a definite point of stoppage may be accurately indicated by the patient.

There are two symptoms which occasionally are present in left colonic growths and which are comparatively important; namely, melena and tenesmus. Tenesmus is noted in direct ratio to frequency as the growth approaches the rectal sphincter; that is, the lower the growth, the greater is the irregularity of the bowel and the more likely is straining at stool to develop. It is an untrustworthy symptom except for rectal carcinoma and may be disregarded as a sign of carcinoma of the colon proximal to the middle of the sigmoid. Blood in the stool or on the stool, on the other hand, is the most frequent symptom of left-sided growths or upper rectal growths. Little confidence is to be placed in the presence or absence of occult blood in the stools as a diagnostic measure. If the blood is bright red, if it is in the stool or on it, and if it persists on repeated examinations, unquestionably there is a lesion distal to the splenic flexure of the colon. Blood is rarely discovered when the growth is in the right side of the colon, even by the more delicate tests for occult blood.

Of greatest importance in the diagnosis of colonic malignancy has been the advancement of roentgenologic technique to the present point of accuracy; it is now possible to parallel the information that has been obtainable for a decade or more in lesions of the stomach and duodenum. The characteristic roentgenologic evidence of malignant disease in the large bowel is so accurate that in 102 cases of carcinoma of the colon beyond the transverse segment, proved at operation at The Mayo Clinic in 1929, error in examination was made in only 3 cases. A filling defect or visualized interference with the integrity of the lumen of the bowel is so pronounced in the majority of instances in which accurate preparation has been made that experience with the fluoroscope promises to continue this accuracy. The barium clysma, roentgenologically controlled, aided by palpitory manipulation, and verification of the results by roentgenography, is the method of

Fig. 1. Roentgen-ray showing carcinoma in redundant loop of sigmoid.

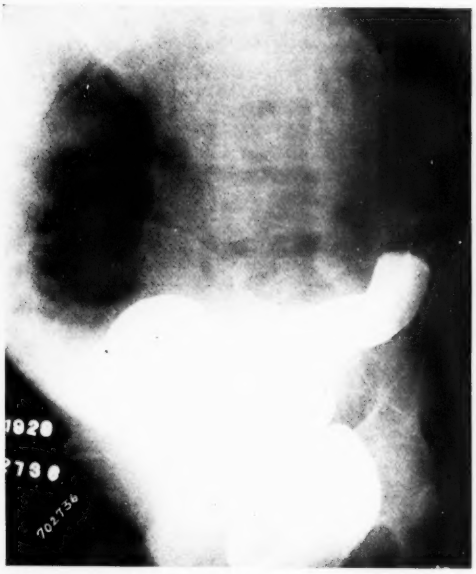

Fig. 2. Annular carcinoma in the descending colon, at the level of the left iliac crest, with obstruction.

choice for accurate localization of the filling defect and for precise interpretation of its pathognomonic characteristics.

To epitomize the symptoms of colonic carcinoma: the most important early evidences of carcinoma in any portion of the colon are change in intestinal habit, as evidenced either by irritability, mucous diarrhœa, or alternating periods of diarrhœa and constipation; localized pain and tenderness without a tendency to disappear; tumefaction, and profound anæmia not accompanied by loss of blood, or, if the lesion is in the left half of the colon, obstruction of the acute, subacute, or chronic variety. In the presence of these suggestive phenomena, it is imperative that a complete gastro-intestinal examination at the hands of an experienced and competent roentgenologist be undertaken, and one may feel great assurance that the lesion will be localized. In this connection, I would strongly emphasize the fact that the loss of weight, cachexia, dehydration, and desiccation so frequently referred to as diagnostic phenomena of carcinoma of the colon, are in reality not symptoms of carcinoma at all but are signs of metastasis and impending dissolution.

CO-OPERATIVE MANAGEMENT

It has been a decidedly beneficial factor in many respects, in the handling of patients with colonic lesions in The Mayo Clinic, to segregate them in a group under the combined care of clinician and surgeon. This is particularly valuable in the pre-operative management which is instituted routinely and which allows advantage to be taken of all the factors of safety in handling this type of case, in an effort to reduce the immediate mortality and, at the same time, to extend the horizon of operability. These factors of safety are: (1) adequate pre-operative rehabilitation, combined with necessary decompression; (2) selection of the optimal time for operation and selection of an operation for the patient rather than attempting to standardize maneuvers to fit all cases of organic lesions to one or two types of procedure; (3) employment of intraperitoneal vaccination with colon bacilli and streptococci, as a routine measure, in an effort to immunize against peritonitis, which is the most common fatal factor; (4) employment, in a large number of cases, of operation in multiple stages; (5) selection of spinal anæsthesia in these cases except for very definite contra-indications; and (6) rigid adherence to a standardized post-operative regimen. Unquestionably, this chain of events has allowed operation to be performed with greater facility in a larger number of cases and with the hope of increasingly satisfactory end-results because of the more radical type of

Fig. 3. Roentgen-ray showing carcinoma of the middle third of the sigmoid.

Fig. 4. Carcinoma of the transverse colon, with a rather extensive defect just distal to the hepatic flexure.

surgical procedure employed. It should be remembered that the standard of efficiency in extirpation of colonic growths is, in the hands of the average operator, the percentage of operability rather than the percentage of mortality and, to increase the operability and at the same time reduce the mortality, measures of rehabilitation and decompression are the most essential factors to be observed.

A great many of these patients, perhaps the majority of them, on admission are in a state of lowered resistance; they frequently are dehydrated and desiccated as a result of obstruction and its concomitant toxæmia and of lowering of the physiologic equilibrium. To increase the general resistance of the patient, dietary and rehabilatory measures are combined with attempts at decompression over a sufficiently long period to reduce, as far as possible, the infection around the growth and the obstruction caused by the growth. Frequently blood transfusions are indicated, and insistence on a large intake of fluid and a high caloric diet are necessary. Twenty per cent fruit juices, candy, rice, butter, eggs, and so forth, low in residue and high in food value, are urged. At the same time, decompression is attempted by constant rectal irrigations with warm saline solutions, supplemented by mild purgation with the fluid extract of senna. The irrigations not only tend to reduce the intracolonic pressure but in rectal and left-sided colonic growths have an important influence on the reduction of infection in and surrounding the growth. Although the vast majority of left colonic carcinomata cause some type of obstruction, by these means, in about 80 or 90 per cent of the cases, it is possible to reduce obstruction, even of the subacute or acute variety, to a point at which the bowel is flat and satisfactory for segmental resection at the time of operation.

By using intraperitoneal vaccine of streptococci and colon bacilli, prepared from patients who have succumbed to peritonitis, I am confident that the percentage of fatal peritonitis has been reduced materially. Routinely, this is employed before operation, being given 3 days before resection. It is a theoretically correct procedure, is undoubtedly one of the most important steps in the pre-operative management, and has unquestionably contributed to the increasingly good results. It has been employed in more than 500 cases, and its advantages are considered as established.

One consideration which I offer with some hesitation is that of the routine employment of spinal anæsthesia in these colonic cases. Without

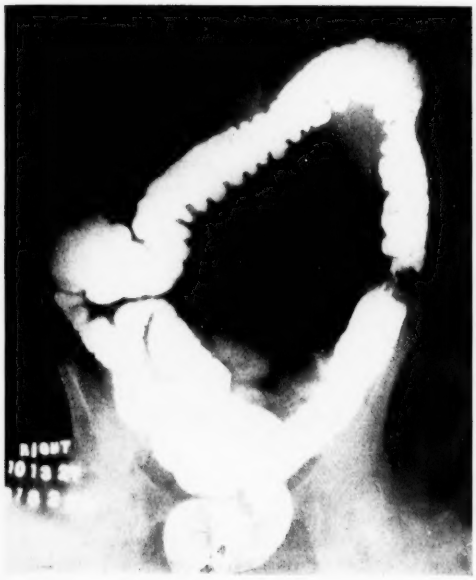

Fig. 5. Annular carcinoma of the descending colon just above the level of the left iliac crest.

Fig. 6. Filling defect in distal part of ascending colon near the hepatic flexure. Carcinoma.

expressing any arbitrary opinion, and in the belief that each surgeon should select that anæsthetic which he personally feels is most satisfactory for this type of case, I have had a most favorable experience in a large series of cases by the use of spinal anæsthesia. The comfort of operating, the bloodlessness of the operative field, and the postoperative freedom from peristalsis for 36 hours, are very well known advantages, which are appealing. On the other hand, I do not believe it is possible to employ spinal anæsthesia routinely without narrowing the margin of safety over inhalatory methods, and yet, in the evaluation of the advantages over the disadvantages in this type of anæsthesia, my personal experience has been in its favor. Certainly, common sense should govern the selection of anæsthesia in every field of surgery, and it is unquestionably true that there has been no single anæsthetic yet developed which is satisfactory in all surgical fields. Each has definite indications and contra-indications, and in the end the choice is based on personal selection by the surgeon. I do not believe that spinal anæsthesia should ever be given by anyone other than a highly skilled and expert anæsthetist, and that he, during the operation and subsequent to it, should maintain a watchful eye on the patient for evidences of falling blood pressure or other complications. In the event that it is properly given and supervised, I subscribe that the danger incident to its employment is reduced to a minimum, and in our experience in the last 3 years, in which we have used it routinely, we have had no untoward immediate effects.

CHOICE OF OPERATION

Several factors influence the choice of operation in the two halves of the colon. The matter of graded operations on either side, however, is of greatest importance. In the right half of the colon, it is my feeling that aseptic ileocolostomy between the terminal ileum and the transverse colon, followed by resection of the right segment at the same stage or a subsequent one, is the procedure of choice. I urge the employment of end-to-side anastomosis rather than lateral anastomosis in this particular instance because of the very desirable feature which the end-to-side method possesses over the lateral, in side tracking the fæcal current and allowing as much reduction of local inflammatory reaction around the growth as is possible. At the time when this anastomosis is made, and I prefer an aseptic type, one may decide whether to do the resection, making the operation complete in one stage, or to abandon the procedure and extirpate at a subsequent stage the segment which harbors the neoplasm. This is a decision which must be made at the operating

Fig. 7. Filling defect in proximal part of ascending colon. The diagnosis of carcinoma was substantiated surgically.

table in each case, on its own merits, and few rules can be laid down otherwise. In my own experience, I have passed through several stages in relation to resection of the right half of the colon, ranging from complete resection and anastomosis in one stage, with decompression by ileostomy in the terminal ileum, to a routine plan of ileocolostomy and subsequent resection in two stages. Recently I have found that in about half of the cases, one may just as satisfactorily accomplish the operation in one stage as in two, with the same mortality rate, and yet I am confident that this maneuver should be reserved for the patients who constitute sturdier risks, who are not depleted, and whose general resistance is capable of combating a formidable surgical procedure. After the anastomosis has been made, in the event one decides to do an operation in two stages, the second stage is readily accomplished and is very simple. It consists in mobilizing the colon, dividing it, and turning in the cut ends. The question of decompression after ileocolostomy is one that has received much consideration, and when decompression is needed it provides a highly desirable safety valve. One may do either an ileostomy of the Witzel type in the terminal ileum, proximal to the anastomosis, or, after resection of the colon and turning in the cut ends by a purse string suture, one may leave the catgut long, bringing it out through the end of the wound, and leaving it as a guide down which one may spear with a forceps on the fourth day if intracolonic pressure increases and untoward symptoms develop. Should it be advantageous to postpone the second stage of the operation for a time, experience is convincing that the interval should be considerable. The urgent desire to complete an operation in one stage should not influence surgical judgment, if by delay, even though it may be long continued, one may, without death of the patient, remove the segment. The economic situation always urges that the operation be done as quickly as possible, and yet one's judgment should not be influenced by economics in dealing with carcinoma, for radical measures are the only measures worth while, and to dally with a carcinoma, or to attack it indecisively, is futile.

The matter of exploration of the abdomen, before deciding on any type of operation in any portion of the colon, is important. It should be carried out routinely, I think, in about the following order: (1) the liver; (2) the aortic glands; (3) the glands at the bifurcation of the mesenteric vessels; (4) the pelvis; and (5) the growth and its adjacent lymphatic structures. The important point to be observed in this exploration is that the growth be palpated last and that its palpation then should be done gingerly and gently. The information one obtains from palpation of the growth concerns: (1) complications, such as formation of abscess; (2) its extent; (3) its mobility; and (4) the presence or absence of enlarged lymphatic structures in the vicinity, which may or may not be malignant, a determination possible only by microscopic examination. Gentleness is essential, since should a complication such as an abscess be present, one may very easily and unsuspectingly insert a finger into the abscess. This will make another complication, which will force resection at an undesirable moment. Likewise, as is easily demonstrated, infection is spread from the primary growth throughout the peritoneal cavity by the examining hand because of the number and the virulence of organisms in and around the growth.

In the left half of the colon, where obstruction is the most alarming symptom, the problem is different from that presented in the right half, even to the anatomical type of bowel which is to be operated on. If the obstruction is acute and the bowel is dilated, œdematous, and filled with material, drainage by cæcostomy or colostomy proximal to the growth is urgently indicated. If,

on the other hand, as happens in the majority of cases, the obstruction is mild and has been largely relieved by pre-operative decompression, resection frequently may be accomplished in one stage, but without anastomosis. I do not believe that primary anastomosis should be carried out in the left colon except in extremely rare instances, and when it is carried out, I think a decompression procedure, proximal to it, by cæcostomy, is always indicated. In the average case, in a mobile segment of bowel, and this means from the hepatic flexure to the middle of the sigmoid, I believe the procedures of choice are: (1) obstructive resection and (2) a drainage operation followed by resection and anastomosis in two stages.

Obstructive resection combines the desirable features of the old type of Mikulicz operation in one stage, making it a radical operation, removing the growth and leaving the bowel obstructed for a period of 48 to 72 hours. I have employed it in a large series of cases, with a mortality rate of about 5 per cent, and its desirable features have been increasingly borne in on me as I have extended the series. The Mikulicz procedure was a local resection accompanied by high mortality, when a large series of cases was considered. At the same time, it resulted in recurrence of the growth in the abdominal wall in 12 per cent of the cases, with the possibility of a higher percentage of intra-abdominal malignant lesions recurring because of failure to do widespread block dissection of the gland-bearing tissues in juxtaposition to the growth. Obstructive resection obviates these disadvantages, makes possible radical excision of gland-bearing tissues with the growth, and, in my experience, has resulted in huge lowering of the mortality rate.

The mobilization of mobile or mobilizable segments of the large bowel down to the middle of the sigmoid is accomplished easily by division of the outer leaf of the peritoneum, which is bloodless, and by rotating the bowel mesially, wiping the glands and the fat of the mesentery inward. The blood supply is ligated close to the root of the mesentery and as large a block of tissue as is feasible is removed. The clamp is left closed for 48 hours at least, preferably for 60 to 72 hours, and then the proximal blade is opened, allowing the gas to escape, which it does if there is intracolonic pressure. The clamp is allowed to remain on the distal portion falling off when it necroses through, about the seventh or eighth day. This leaves the two blind "gun-barrels" much as in the old type of operation. When the spur of this is cut out by an enterotome, complete healing takes place spontaneously in a high percentage of cases (about half in my series) if the mucous membrane is not attached to the cutaneous margins and everted, and if sufficient time is allowed before attempt at closure of the colostomy opening is made. This time customarily is around 6 weeks to 2 months, and, in any event, the longer one waits before attempting closure of the colostomy opening, to allow regression of the inflammatory tissue, the more likely is closure to be successful at the initial attempt. This type of operation, of course, never can be undertaken in the face of any type of obstruction and in the event of obstruction one must have at hand other stratagems which necessarily consist of decompression operations followed by resection and anastomosis. The obstructive type of operation, therefore, may frequently be done in one stage, whereas the other is necessarily an operation in multiple stages.

MORTALITY.

Mortality statistics in surgery of the colon and rectum have fortunately been slightly revised downward in the course of the past decade, and yet they continue relatively high in comparison with mortality statistics for other chronic ailments of the gastro-intestinal tract. Many reasons are perfectly obvious for this discrepancy which, however, is more apparent than real. I mean that the organic lesions of the large bowel, which necessitate surgical attack on it, are not only of a serious but also of a complicated nature, and the very type of structure which they affect adds difficulties rather than encouragements. The infection in and around growths, the uncertainty of the blood supply, the distribution of lymphatic structures, and the technical difficulties incident to mobilization and resection are well known to all. Nevertheless, a note of encouragement is present and this should, I think, be given prominence by surgeons rather than the hitherto somewhat widespread pessimism that has attended surgery of this particular region. The end-results following successful extirpation of colonic and rectal growths are not only comparable to, but superior to, the ultimate end-results of surgical attacks on malignant growths of the balance of the gastro-intestinal tract. I think that this statement is readily proved by comparison of statistical data from the clinics of various surgeons throughout the world. An accepted mortality rate of about 10 per cent is, in our hands at the clinic, felt to be not unreasonable. W. J. Mayo, many years ago, uttered the dictum that to decrease the mortality rate below this figure laid one liable to the accusation that many patients who might be benefited were being refused surgical help. In other words,

the operability of carcinoma of the colon and rectum should be the deciding factor rather than the immediate mortality rate.

In The Mayo Clinic, in 1929, the operability rate in our series was 57.5 per cent. Operability unquestionably differs in the hands of different surgeons and is largely a matter of individual judgment. Judgment obviously should always be tempered with discretion, and yet lack of courage in dealing with diseases of the large bowel, condemns many patients to early death by refusal of an attempt to extirpate the growth. The horizon of operability must not be narrowed to such an extent that the rate of immediate mortality is too satisfactory, for if this is done, fewer persons out of a given hundred will be alive and free from recurrence at the end of 5 years than if a higher mortality rate from the immediate operation had been accepted. The two segments of the colon above the rectosigmoid have been subject to increasingly satisfactory attack by operation under co-operative management of surgeon and internist and individualization and segregation of the patients which permit of selective stratagems. Of the first segment, which includes the terminal part of the ileum, the cæcum, ascending colon, hepatic flexure, and transverse colon around to its middle, namely, that portion developed from the midgut, in 1929 at The Mayo Clinic, there were 160 operations with 14 deaths, a mortality rate of 8.7 per cent. These operations were for organic disease of the large bowel, carcinoma in the large majority of instances, and in addition for hyperplastic tuberculosis and repair of chronic fæcal fistulas. I have not been impressed with the utility of operations for prolapse of the colon and other plastic operations aimed at the relief of so-called stasis and allied complaints, and I have never been guilty of the performance of any operation for this type of ailment.

On the left half of the colon, which is considered that part which runs from the middle of the transverse colon down to the rectosigmoid, there were 227 operations with 17 deaths, a mortality rate of 7.4 per cent. In recent years, the increasing use of obstructive resection, which is largely a one stage operation, has reduced the number of operations in this particular portion of the large bowel and the mortality rate represents practically a mortality figured on the basis of number of patients rather than on the basis of number of operations.

The improvement in diagnostic methods then, particularly in roentgenoscopy and proctoscopy, permitting earlier recognition of lesions of the large bowel and rectum, together with emphasis on the importance of more routine examinations, particularly after the development of the earlier symptoms of intestinal dyscrasias, or as a part of the routine yearly examination, will bring this group of people to examination and operation at an earlier time. These measures will undoubtedly increase the operable group to more favorable proportions and, at the same time, will offer much more reasonable hope for a satisfactory end-result.

VERTICAL SKIN-GRAFTS FOR RECONSTRUCTION OF EYEBROWS

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THE peculiar appearance resulting from loss of eyebrows is so conspicuous and conducive to mental suffering that reconstruction of them is often imperative. The improvement in appearance is striking.

Eyebrows have been made by using pedicle grafts of the scalp but this requires extensive and somewhat disfiguring operations. Thiersch grafts do not convey hair. Wolfe grafts convey hair but if from the scalp the thickness is so great that due to necrosis only about one-fourth of the hairs survive. In full thickness grafts of the scalp the mass of tissue is too great to be vascularized before partial necrosis sets in. An eyebrow is one-third of an inch wide and hair follicles in the scalp extend one-fourth inch below the surface. Therefore, a strip of Wolfe graft of such bulk would probably not live, and, even if its outer zone should survive, only a few hairs would live in the presence of the central sloughing.

As the cutting of the skin-graft in the usual way, in a plane parallel with the surface of the skin, would necessitate too great a thickness for the graft to survive I cut a thin vertical slice from the scalp and implant it along the brow vertical to the surface of the skin. The process can be repeated three or four times at intervals of a month, each slice being implanted above the last until the eyebrow is of sufficient breadth. Each successive slice is made shorter at its outer end, so the eyebrow will be thicker in its medial third and taper laterally. In the inner fourth of the eyebrow, the implants are made somewhat slanting to the surface. Each vertical slice is as thin as a millimeter and a half and is contacted with vascular tissue on each side so its vitality is assured. In a month it is sufficiently vascular to nourish the adjoining side of the next slice implanted beside it. The technique is as follows:

Three Bard-Parker scalpel blades with between them two strips of sheet metal (each a millimeter and a half in thickness) are clamped together by two Mayo hæmostats. The three blades are thus held parallel and each a millimeter and a half apart and the two hæmostats are grasped together as a handle.

An area of scalp in the midoccipital region, which is the last part to become bald, is shaved and painted with 50 per cent tincture of iodine. With one vertical stroke of the tri-bladed scalpel down the midline of the scalp in the direction of the hair two equal slices of graft are cut. A deep incision is then made along the line of each eyebrow and the slices of scalp are implanted in these and secured in place with fine sutures. The upper ends of the graft should be mediad so the hairs will point laterally. Each stitch catches one edge of the incision, passes through the graft

Fig. 1.

Fig. 2.

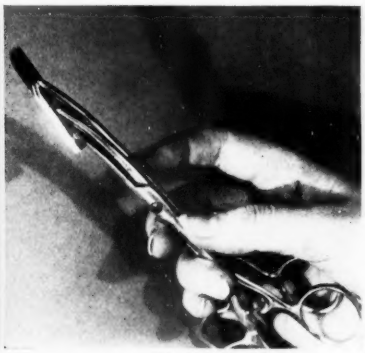

Fig. 3.

Fig. 1. Case G. D. Appearance of patient March 4, 1929, before reconstruction. Regions of eyebrows, scalp, and face have been Thiersch grafted. Most of each eyebrow has been destroyed. There are also contracting cicatrices of face, defect in upper lids, defect in right ala nasi, and deflection of nose.

Fig. 2. The first slice of vertical hair-bearing skin-graft has been placed in the line of each eyebrow. Also upper eyelids have been partially reconstructed by epithelial inlays.

Fig. 3. Three-bladed scalpel for cutting equal slices of vertical skin-grafts, made by clamping together three Bard-Parker blades with strips of sheet metal between.

Fig. 4.

Fig. 4. September 20, 1929. Eyebrows partially reconstructed. Additional slices of vertical skin grafts added later. Skin is being waltzed from clavicular regions to face; a second epithelial inlay added to left upper eyelid.

Fig. 5.

Fig. 5. June 27, 1930. The new eyebrows have partially grown. New skin has been supplied to eyelids, tip of nose, right ala nasi, and each side of face. Also, a topee is worn.

Fig. 5A.

Fig. 5A. Appearance of the eyebrows.

Fig. 6.

Fig. 6. Case G. M. December 15, 1930. Appearance following severe burn after forehead and upper part of face have been Thiersch grafted. Defect of right ala nasi shows. Bilateral ectropion has been corrected by epithelial inlays reaching from eyebrows to eyelids. There is a total loss of eyebrows. The first strip of each new eyebrow has just been sutured in place.

Fig. 7.

Fig. 7. Two strips of vertical hair-bearing skin-graft have been placed for new eyebrows; more will follow. Right ala nasi is being reconstructed by pedicle graft.

Fig. 8.

Fig. 8. Close view of partially reconstructed right eyebrow showing hairs now 1 inch long. Area of epithelial inlays of upper lids reaching from eyelashes to eyebrows are seen.

just beneath the surface, and emerges catching the other edge of the incision. The wound in the scalp is closed until the next slice is to be added. The procedure can be done in an office under local anæsthesia.

The grafts take with a surety, and, in the several cases in which I have used them, apparently every hair lives and thrives. At first, the new-growth of hair is thin and brittle but a few months later becomes healthy and strong.

In each of the cases pictured in this report the eyebrows were lost from third degree burns. The improvement in appearance by the acquisition of eyebrows was marked.

PRINCIPLES AND TECHNIQUE INVOLVED IN THE PRESENT DAY TREATMENT OF CANCER OF THE UTERINE CERVIX

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THE micromechanics of healthy epithelium in the generative tract have been considered elsewhere in connection with the way in which the diseased epithelium responds in cancer of the uterine cervix. The present study has to do with the reaction of cancerous epithelium of the cervix to therapy, particularly toward radiotherapy. By ascertaining the reasons for failures in technique, certain principles can be established which are basic in treating cervical cancer and lead up to standardization as far as the individuality of the problem will permit.

It is now a surgical platitude that no operation deserves to be considered in cancer of the uterine cervix, unless it includes the outlying extension and metastatic deposits together with the primary growth. Incomplete procedures only disseminate the tumor and create a situation which makes it more inaccessible to radiation. In the light of what is known about extension and regional drainage in malignant growths of the cervix, simple panhysterectomy must be discarded as an insufficient measure.

Initial steps in an extended operation consist in the demonstration and isolation of the ureters in their course through the broad ligaments to the base of the bladder. In addition to the removal of the uterus and adnexa, the technique entails an excision of the parametrium close to the pelvic wall and the resection of the vagina at least 5 centimeters beyond the growth.

There is no question that the extended or radical operation is of major character and the immediate mortality is high. According to Lynch, among 3,239 patients who were subjected to operation by various surgeons there were 534 operative deaths. This amounts to 16.5 per cent and means that about one-sixth of the patients do not survive the operation.

On the other hand, of this surgical series, 1,313 patients or 40.5 per cent remained clinically well after 5 years. In comparison with this, of 646 patients who were treated solely by radiotherapy, 236, that is 36.5 per cent, could be recorded as 5 year cures. In some of the individual groups, a decidedly higher percentage is attained.

It is difficult to correlate statistics from various sources because of the great personal equation that enters into the classification of patients according to the clinical stage of the growth. As a fair average it might be said, in round numbers, that the 5 year cures which have been obtained by radiotherapy amount to about 36 per cent in operable, 26 per cent in borderline, and 16 per cent in advanced cases.

This shows that although the results with radiological methods in very early carcinoma so far have not surpassed those of surgery, the scope of radiotherapy is greater. More than this, it lends itself to the treatment of those advanced growths in which 5 year cures are no longer attainable by any means and holds out the hope that the span of life may be prolonged and often doubled.

In borderline cases in which the degree of invasion of the cellular tissue of the *doubtful space* between the broad and sacro-uterine ligaments always remains somewhat uncertain, radiotherapy is unquestionably preferable to surgery because of the lesser risk and greater promise.

In the early cases which belong to the truly operable class, it is the fact that the mortality after operation is so high rather than the guarantee of a better result, that may be determining. However, exceptionally in small epitheliomata of the cervix in lean women who also are otherwise surgically fit, operation may still be considered justifiable in the hands of surgeons who are thoroughly experienced in pelvic technique. At least under these circumstances, surgery leaves very little doubt that any cancer nests in the vicinity of the growth have escaped the therapy. The fact remains that there are instances of comparatively early carcinoma of the cervix in which radium treatment combined with high voltage therapy has failed to achieve a 5 year cure. But it cannot escape those who are working in this field that the technique is still capable of much improvement and that perhaps, after all, the question is purely one of adequate radiation. At least two instances can be recalled at the Cancer Institute in which this criticism is unmistakably tenable.

A vital problem has been how to secure the uniform, not the focal, destruction of cancer cells; another problem, the sufficient radiation not only of the primary growth but also of its more inaccessible, outlying parts. An early recurrence locally probably signifies that some malignant areas have been allowed to remain in the cancerous

cervix, while later recurrence usually means that the outposts of the cancer have been insufficiently treated. Further study is necessary which correlates the exact anatomical location of the recurrence with the special technique employed in particular cases.

It is a little more than two decades since the first attempts were made to use radium in tumor therapy. Robert Abbe in this city probably was the first surgeon to apply it to uterine cancer. There are some who will recall the practical inconvenience of carrying about small quantities of this precious substance from one sufferer to the other.

Then there was found a way of collecting from radium the emanation on which its radioactivity depends. Instead of applying the radium itself, measured quantities of the gaseous emanation were available in glass capillaries which were then enclosed in small capsules or applicators. This made it possible to treat many tumors at once, with the emanation that was obtained from an otherwise limited supply of radium. The physical and chemical effects, in broad terms, are the same as for the radium salt itself which has first to produce emanation before this can resolve itself further to liberate radiant energy.

The radium emanation or radon yields α-, β-, and γ-rays. The α-rays do not penetrate tissue and have no therapeutic value. Only the β- and γ-rays have been applicable to cancer.

After the emanation or radon has been collected in sealed glass capillaries, the α-ray is withheld but the β- and γ-rays are available. When the capillaries are placed in a metal container of sufficient wall thickness for screenage, the primary β-rays cannot escape and the γ-rays alone pass through the filter. In this way, relatively pure γ-ray activity is obtained.

One millimeter of lead is capable of absorbing 99.9 per cent of the primary β-rays. The value of other metals as filters in comparison with lead depends directly on their relative density. On this basis, to obtain equivalent β-ray screenage, the capsule wall thickness must vary according to the metal of which it consists: platinum 0.5 millimeter and gold 0.6 millimeter; silver or lead 1.0 millimeter; steel or brass 2.0 millimeters; aluminum 4.0 millimeters.

Thus one-half the thickness of platinum suffices to give about the same filtration as lead. Because of the lesser wall thickness which is required, capsules that are less bulky can be constructed by using platinum, without, in any way, reducing the screenage.

Theoretically, the small fraction of 1 per cent of β-rays that escapes with this screenage, together with some of the other soft γ-ray components, seems negligible; but, practically, it is not.

No real disadvantage can accrue from using ampler screenage with platinum since no more than a 2 millimeter wall thickness is probably ever necessary to insure satisfactory filtration. This still permits the construction of a capsule which is not too large for intra-uterine as well as extra-uterine application.

With this added filtration, however, the increased absorption of γ-rays by the metal becomes a factor. In determining the quantity of the radium salt or its emanation that each applicator shall contain, an allowance must be made on account of the loss of available γ-ray activity which is due to this absorption. According to figures obtained from S. Schneiderman, 0.5 millimeter of platinum absorbs 4.90 per cent or about one-twentieth of the γ-rays; while 1.0 millimeter of platinum takes up 9.56 per cent, that is nearly one-tenth, and with 2.0 millimeters of this metal the absorption rises to 18.4 per cent, or almost one-fifth.

In other words, if 50 millicuries is intended to be the available working dose, then the initial dose in the capsule must be one-twentieth greater when the platinum capsule is one-half millimeter thick, therefore 52.5 millicuries; one-tenth more when the filter is 1.0 millimeter thick, that is 55 millicuries; and nearly one-fifth must be added for the standard platinum capsule of 2 millimeter wall thickness, namely 10 millicuries, making the initial dose 60 millicuries, in order to obtain an available working dose of 50 millicuries.

Perhaps partly because the uterus forms a naturally well adapted receptacle for the radium applicator, the outstanding work with radium on cancer has been done in gynecology. It is fortuitous that this has been so, since carcinoma of the uterine cervix has proved to be particularly difficult to approach by surgery.

Clinically speaking, the average cancer of the cervix includes about 36 cubic centimeters of primary tumor bed. If 0.9 to 1.0 millicurie must be delivered as a lethal dose to each cubic centimeter of this tissue, then a total dosage of 4,300 to 4,800 millicurie hours will be required solely to destroy the zone from which the tumor grows. This dosage does not include that which shall be necessary to reach the extensions of the primary growth into outlying districts and its secondary deposits along the anatomic lines of the regional drainage.

It has become evident in practice that by seed implantation alone, this requirement is not adequately met. When glass seeds were used with a

potency varying from a minimum of 0.3 millicurie to a maximum of 0.5 millicurie each, at least two or three of these seeds had to be allotted to each cubic centimeter of tissue in the periphery of the tumor. Although no radiation was wasted on the exophytic and decadent portions of the growth, nevertheless in order to escape traumatizing the cancer bed itself too extensively by numerous implantations, instead of two or three seeds, actually seldom more than one seed to the cubic centimeter was used. This means that at one session the tumor received directly only about one-half or one-third of the dosage which it should have had. With the idea of making good this shortage the procedure was repeated once or twice after an interval of 3 to 6 weeks. In some instances instead of the vaginal, the transperitoneal, route was chosen.

However, the great importance of the time-span through which the dosage is distributed became apparent with the experience that in spite of the usual co-ordination of the treatment with high voltage, some portions of the primary growth remained active, reasserted themselves, and gradually made headway, as it were, over the radiation, or escaped beyond its control.

Seed implantation alone, therefore, without reenforcement, is too feeble for the needs in dealing with cervical cancer. While the total initial dose is insufficient and further dosage must follow, it takes nearly 4 days before one-half of the initial dosage is spent upon the tissues, so that it may become effective and not before the end of one month has all the radiant energy been dispensed. There can be little doubt that as time elapses under incomplete radiation, some parts of the primary mass will continue to grow. *In order to prevent the cancer from becoming uncontrollable, the lethal dose must be given as rapidly as the radiated tissues and structures will permit.*

Another inadequacy in the therapy by means of radon seeds is referable to the production of what may be called barrier sclerosis, before the invading carcinoma is completely destroyed. Microscopical sections of the shrunken cervix after this treatment not infrequently show a massive mesh of altered connective tissue in which groups of dormant cancer cells are imprisoned that subsequently may become active. Sometimes the site of the tumor appears healed clinically when in a later follow-up examination, a cancerous patch is discovered which has broken through the sclerosed surface. All this reveals that the destruction of cancer cells, instead of having been uniform, has occurred in scattered areas and is focal in character. These minute groups of cancer cells cannot be localized clinically, and any degree of precision in the implantation of seeds is no longer possible. Besides this, the sclerosis barrier makes the situation more difficult to deal with no matter what method of radiation is subsequently chosen.

It is primarily the catalysis of the cancer cells that is wanted and not so much their incarceration in connective tissue. The primary β-ray emitted by the unscreened glass seed is without question largely responsible for inciting excessive sclerosis before all the cancerous elements have been reached.

The tissue damage caused by the implantation trocar calls for replacement by connective tissue. The seeds which remain imbedded in the tumor, are minute foreign bodies and as such play a part by mechanical irritation. But these factors are minimal when compared with the irritant action upon the environment of the implant by the escaping β-rays. There is necrosis with the seed as its center; and in the surrounding connective tissue both replacement reaction and defensive response. These changes, however, are not far-reaching but limited to a small radius; they are focal because the β-ray does not penetrate, but is absorbed in the tissues of the tumor within a few millimeters of its source.

There is no question about the effectiveness of the primary β-ray in the immediate vicinity of the seed but the problem is the effacement of the doubtful areas which lie beyond the short range of the seed. If the β-rays could be evenly distributed to every part of the tumor, then the therapeutic result would be perfect. The primary β-ray is under the existing circumstances, however, a hindrance rather than a help and efforts to eliminate its interfering action were made by improving the filtration.

Instead of using glass seeds, gold capillaries were calibrated into gold seeds. But the wall thickness of the gold implants could scarcely be more than 0.3 millimeter, and their size and increased ponderosity made them much less satisfactory for embedding in the tissues and with all this disadvantage the screenage was not even one-half of what was needed to exclude the β-ray and secure pure γ-radiation.

In another procedure for the intratumoral or interstitial application of radium, a number of needles with a definite radon content are inserted longitudinally into the cancerous cervix. When the desired dosage has been delivered, the needles are removed. This may conveniently be done in 4 days, at which time one-half of the total γ-ray activity will have been spent. In this way a

considerable dosage may be obtained. Thus if 4 needles of 10 millicuries each have been inserted, then the total dosage of which these needles are capable is 5,332 millicurie hours, since 4 times 10 millicuries times 133.3 equals 5,332 millicurie hours. One-half of this dosage, that is 2,666 millicurie hours, will have been received in somewhat less than 4 days—the time when the needles are again extracted.

These hollow needles are made of platinum. The relatively slender caliber which is required for the purposes of interstitial insertion restricts the wall thickness of these needles to 0.4 millimeter at the most and this is clearly not sufficient to bar all the β-rays from reaching the tissues.

Besides this, a variable amount of necrosis occurs about the needles because secondary β-rays are developed where the bare surface of the needle is contiguous to the tumor tissue. Needles that are open at one end and have simply been plugged with paraffin should not be used, for it is evident that unfiltered rays must gain exit at this point.

In the treatment of the cervix for cancer, the sphere of usefulness of implants and needles is limited to particular problems. An isolated vaginal deposit can sometimes be conveniently removed by implanting seeds. Transperitoneally, in rare instances, seeds may be used to attack a secondary focus of malignancy where no other method is applicable. When a follow-up treatment of the sclerosed and shrunken crater site, to which the capsule does not readily adapt itself, is necessary because there is evidence that beneath the surface some areas of the primary growth are still active, the introduction of radon needles may be preferable.

What is desired is a simple, standardized procedure which can be followed as a routine. The platinum capsule constitutes a unit which is adaptable to the treatment of most carcinomata of the cervix.

The radiation of the growth is attained by the intrapelvic and extrapelvic route. The intrapelvic treatment resolves itself into the intrauterine and the vaginal application of radium. The capsule is the essential integer in this procedure. The aim is to arrange a number of capsules in protective containers which conform to the local requirements. The extrapelvic phase of the therapy consists in radiation accomplished by means of the γ-ray pack or, where this is not available, the high voltage X-ray.

The intra-uterine applicator consists of three platinum capsules that are enclosed in tandem in a single, soft, metal-free, rubber sac.

By means of dressing forceps the applicator is carried up to the fundus of the uterus, so that one capsule occupies the fundal, the next the intermediate, and the third the cervical segment of the uterine cavity or otherwise it reaches the level of the crater rim. A linen thread about 8 inches long is fastened to the lower end of the rubber container. Sterilized white vaseline facilitates the introduction and reduces the trauma.

If the canal is too narrow, graduated sounds wiped with sterile white vaseline are preferred to the ordinary or parallel blade dilator. If a biopsy of the tumor is required, it is obtained after the intra-uterine applicator has been inserted.

Curettement, extensive excochleation, or cautery and all unnecessary manipulation or trauma are avoided. If an exophytic mass prevents proper access to the active portions of the growth, it is best ablated near its base by means of the high frequency cutting electrode.

The vaginal preparation consists in simple cleansing with warm 1 per cent aqueous lysol solution. The nurse uses the digits of her gloved hand instead of the sponge stick. In a large series (April, 1926 to November, 1929), solupinol, a steam distilled pine oil, has been used in place of lysol. It is considerably milder than phenol in its antiseptic action, as laboratory tests by R. C. Schleussner have shown, but nevertheless seems peculiarly satisfactory in dealing with the putrefactive organisms which play a part as soon as the surface of the growth is broken. Where there is ulceration, a coating of tincture of iodine can easily be applied directly to the lesion.

Even if the patient has voided, the soft rubber catheter is used to make sure that the bladder is empty. The colon has been properly flushed by means of a warm water enema on the previous day.

Spinal analgesia with novocain gives the most perfect relaxation for the preliminary examination, makes the procedure painless, and causes no interruption in the upbuilding plan immediately afterward.

The platinum capsule is 25 millimeters in length or less. It has a wall thickness of 1 to 2 millimeters and an outer diameter of 4 or 6 millimeters. Its end can be unscrewed to receive the glass capillaries which contain the radon. The rubber sac is one-half millimeter thick.

Each capsule carries an average of 27.5 to 30 millicuries of radium emanation and yields about 1,000 millicurie hours of pure γ-radiation during an application lasting 48 hours. The total radiation delivered by the three capsules amounts to 3,000 millicurie hours. By doubling the millicurie

content of the cervical capsule, the total radiation can be raised to 4,000 millicurie hours. This allows for loss by absorption which amounts to one-tenth for 1 millimeter of platinum or one-fifth for a 2 millimeter capsule wall of the same metal. In other words, to have the working effect of 25 millicuries actually, 27.5 millicuries must be carried if the capsule has 1 millimeter filtration, and 30 millicuries if the filtration is increased to 2 millimeters.

The radiation of the cervicovaginal junction, adjacent vaginal segment, paravaginal and parametrial lymphatics, and connective tissue, is attained by means of the *vaginal* applicator.

The vaginal applicator must be fitted to the rather varied conformation produced by the cancerous growth and as far as possible, should be placed in direct contact with the tumor and its extensions along the vagina. Many of the rigid devices as well as the ordinary colpostat have therefore had a limited use.

A form of vaginal applicator which is simple, quite adaptable, and readily improvised, is the *radon ring*. It consists of a ring of metal-free rubber tubing of 11.5 millimeters outer diameter, with 2.5 to 3 millimeter wall thickness and a 6.5 to 6 millimeter lumen which is just large enough to hold the capsules snugly. In a typical case the radon ring harbors three platinum capsules of 2 millimeter screenage and the same construction as those selected for intra-uterine use.

When the ring is in place, two of the capsules are in a favorable position while acting locally also to discharge the excess radiation into the cellular tissue and lymphatics of the retrolateral space between the broad and sacro-uterine ligaments on each side. These capsules are charged with 30 millicuries of the radium emanation. The third capsule lies directly anterior and contains but 15 millicuries of the radioactive gas. In addition to its surface effect, this capsule has to supply radiation to the subepithelial and submucous lymphatic meshes of this segment of the vagina as well as to the small area of vesicovaginal cellular tissue just in front of it. If this radiation is allowed to continue for 48 hours the total dosage received vaginally will amount to about 2,500 millicurie hours.

After deciding to what points on the vaginal aspect of the tumor the direct application is to be made, or along what segments of the advancing crater edge in the vaginal wall, the diameter of the vagina is measured or estimated at this level.

Because the circumference of a circle is approximately three times its diameter, the length of tubing required for the ring is about three times the diameter. Actually with the thick tubing that is employed, the piece must be cut about 1.5 to 2 centimeters shorter because of peripheral stretching of the rubber tube when it is fashioned into a ring. After the ends of the rubber tube have been joined by means of a dumbbell shaped unit of unpolished wood, a ring is obtained which is of the desired size. The joint is best placed posteriorly. First the anterior capsule is pushed to the middle of the tube; then the retrolateral capsules follow on each side; finally the open ends of the tube are connected by means of the dumbbell unit.

If it is desirable to apply a capsule to the tumor surface at some point within the ring, a section of rubber tubing easily can be attached to each side of the ring by making a small longitudinal slit or button hole at the proper level and using the dumbbell unit. In this way a segment of rubber tubing which acts as the capsule holder, can be firmly fixed within the ring.

If, because of involvement, the diameter of the vagina at the level of application is less than 4 to 5 centimeters or 1½ to 2 inches, the radon ring is not practicable as a capsule carrier. A piece of the rubber tubing doubled upon itself and joined by means of a dumbbell unit which is inserted into button hole slits made in the contiguous limbs of the tube, forms a twin tube which can receive two capsules side by side. Sometimes no more than a single section of rubber tubing with a rubber stopper at each end can be used. The single tube, the twin tube, or the radium ring are applicators which can be improvised easily in a few minutes by using standard caliber, metal-free rubber tubing and the dumbbell joints.

Before the vaginal applicator is inserted, it is wrapped with sterilized vaseline gauze strip or simply covered with a heavy coat of vaseline.

Sterile vaseline gauze strip packing displaces the bladder forward and the rectum backward and keeps the vaginal applicator in place.

Whenever this can be done, both intra-uterine and vaginal applicators are used at one session. After a 48 hour period of radiation, both are removed. The patient receives a douche with 1 per cent solupinol in warm water and a warm water enema. She is allowed to rest at least 1 or 2 weeks before the intrapelvic therapy is reenforced by any extrapelvic procedure.

After the use of radium, a slight elevation of temperature occurs which usually does not exceed 101 degrees F. rectally. This is somewhat analogous to the protein fever which reaches its greatest rise within 36 hours after an aseptic operation. If the pyrexia goes beyond this maximum rise, an infection is likely to be responsible

and the radium has to be removed. It is a serious violation of good judgment to institute radiological treatment when an active pelvic process exists. The radiation is not well tolerated by the tissues which surround the cancer territory when these have been acutely infected. Their resistance is temporarily diminished because of the toxic action of pathogenic organisms. Gangrene of the adherent fallopian tube and appendix has occurred in such a situation subsequent to the intra-uterine application of radium.

Nausea and vomiting of small quantities of bilious fluid, may occur at the height of the process and are perhaps due to split protein toxicosis from the breaking down of the cancer tissue.

The chief complaint is often the dull pain in the back. It is clearly of pelvic origin and localized characteristically about the posterior superior interspinous line.

There may be frequency of urination; but no real dysuria, no more than a complaint of slight burning on voiding. Catheterization or bladder drainage seems meddlesome; no harm can come from the visceral shifting caused by the normal filling and emptying of the bladder.

Exceptionally there may be a cystitis or a proctitis which takes several weeks to subside. Proctitis was more frequent formerly when rectal application was used to treat the posterior parametrium. The rectal mucosa is so much more sensitive to the application of radium than the uterine cavity or vagina, that the procedure is no longer one of choice.

A loop of the ileum frequently lies in the posterior cul-de-sac. Vaginal packing displaces it from this position. It has happened that a loop of small bowel which was contiguous to the dorsum of the uterus was damaged during the intra-uterine use of radium. A radium burn might lead to adhesions of the bowel to the uterus, and intestinal obstruction. An unduly large dose of radium with insufficient screenage of the primary β-rays may readily invite such a complication.

It is good practice to place the vaginal packing securely so that the nurse may change the posture of the patient during the 48 hour session of radium treatment. By following this plan instead of enjoining the patient to remain constantly on her back, the relations of the pelvic viscera are shifted to a sufficient extent to avoid the continuous radiation of one surface of an organ.

The anæmia, particularly in advanced cancer of the uterine cervix, takes the form of a chloro-anæmia. There is a moderate reduction in the total number of erythrocytes, but the hæmoglobin is considerably decreased so that the individual red cells are quite pale. The hæmoglobin may be as low as 30 to 60 per cent and is the index of the chlorosis and not of the anæmia due to uterine bleeding. The clinical course, in most instances, shows a disproportionate drop in the blood color index while relatively little uterine bleeding is going on. It may be that the hæmolytic products which are set free at the site of cancer necrosis are causal. If the chloro-anæmia is not the direct outcome of a loss of blood and there are hæmolytic substances actually present in the blood of these patients, it is perhaps comprehensible why the response to transfusion of blood is, on the whole, not very satisfactory.

In the larger degenerating tumors there is apt to be a slight hyperleucocytosis of the polymorphonuclear variety. With radiation a leucopenia may be induced. This is probably traceable to extensive aggregations of polymorphonuclear neutrophiles at the cancer site which undergo dissolution with the cancerous growth. For the time being, the demand cannot be met by the supply and a transient leucopenia develops. If the leucopenia does not disappear promptly this implies a serious incompetency on the part of the blood forming organs.

It is to be taken into account that in applying the vaginal ring, the capsules are *excentrically* and not centrally situated and at least 2 to 2.5 centimeters distant from the uterine axis. The rays from this applicator therefore are more effective in the periphery than those which emanate from the uterine source.

If there is mobility of the structures as in patients in whom the doubtful areas are not extensively invaded, the radon ring may be brought still closer to the pelvic wall in either of these districts. To accomplish this, the ring is weighted by inserting several plugs of lead or bullets in tandem and together with the capsules. By its gravity the ring will necessarily shift in the direction toward which the patient is inclined.

In the routine treatment, which includes both doubtful areas, the patient is tilted by the nurse alternately into a right or left semilateral position, from time to time, while a pillow supports the hollow of the back.

The number of γ-rays emitted by even a small quantity of radium, is probably infinitely greater than the actual number of cells in any cancerous growth. Individual or dispersed rays cannot have a lethal effect. A certain degree of concentration may stop mitosis or induce temporary suspension of cell activities, but, with greater concentration, the cell becomes irreparable and disintegrates in nucleus and body.

The problem is how to deliver the γ-ray activity in proper concentration to the cancer district without dealing a damaging charge to the sound organs and tissues which intervene.

One solution is based on the application of the principle of crossfiring. The penetrating power of the γ-ray is not at fault. It takes about 20 centimeters of soft tissue to absorb these rays entirely. The fact is, however, that the bundles of rays become dispersed; their concentration or intensity decreases rapidly, and inversely to the square of the distance they have to traverse.

So it happens that the therapeutic effect, as far as the destruction of cancer cells is concerned, is actually lost at a distance of 2 to 3 or 4 centimeters from its source. Since the radii of the true pelvis at this level vary between 6.0 and 6.5 centimeters, it is evident that the remoter foci may not come within this range.

By using in addition the γ-ray pack in *extrapelvic* treatment, by means of crossfiring the γ-rays can be made to converge at any point in the pelvis. The γ-ray beams, otherwise attenuated by dispersion, are re-enforced by others which enter from another angle or field. The plan is to choose the focus for the crossfiring rays so that it will lie within those districts which would otherwise have received insufficient radiation.

The thought is not new that instead of X-rays, the γ-rays from larger quantities of radium could be used similarly in extrapelvic treatment in the form of an adequately constructed radium pack. It probably originated with Janeway more than a decade and a half ago.

Since, in all of the insufficiently radiated zones, the cancer must continue to grow, the central should be supplemented by the peripheral radiation at the earliest moment possible.

When the right or left iliac regions are chosen as portals of entry, the patient lies on her back. For the right or left parasacral fields she is placed in the ventral posture. The abdominal organs are shielded with lead. In both postures a pillow is put under the patient near the iliac crest. This helps to turn the pelvic inlet toward the source of radiation so that the rays can be directed into the true pelvis. For better crossfiring effect on the periphery, the right side front and back are radiated on the same day; the left side front and back on another day. Or else both sides, front and back, are taken in turn on the same day. In this way, the more inaccessible cancer cells that have been insufficiently radiated will receive a crossfiring dose before they have had time to recover.

In cancer of the cervix, a vulvar field for extrapelvic radiation is usually not selected, because the central sections of the cancer have previously been more directly influenced by the intrapelvic treatment.

Hypogastric or sacral portals of entry are generally avoided. The bladder and rectum have already been the inavoidable targets for aberrent rays during the *intrapelvic* application of radium.

Essentially the γ-ray pack consists of a massive cup of lead which holds, in multicentric distribution, a large quantity, 2 to 4 grams, of radium usually in the form of radium sulphate. The ponderous metal of which the cup is made acts as a shield against the radium on all sides excepting its open end through which the filtered rays are allowed to escape. The filtration amounts to somewhat more than the equivalent of 1 millimeter of platinum which clinical experience so far has shown to be ample for this form of therapy. The radium pack is never close to the skin, but as a rule is operated at a distance of about 10 to 15 centimeters from its surface. A sliding mechanism allows it to be raised or lowered. The pack is suspended from the sliding mechanism by means of a universal joint so that it can be adjusted to any angle or fixed in any direction.

A 4 gram pack is in the possession of the Radium Institute of Paris, another in the General Memorial Hospital of New York. If a more or less advanced carcinoma of the cervix requires a dosage of approximately 240,000 milligram hours, the pack makes it possible to deliver this large dosage within 2 or 3 weeks without rendering the individual treatment altogether too trying for the patient in point of duration. With the 2 gram pack which is operated by W. H. Cameron of this city, the corresponding plan would be to administer such a dosage through a longer span of time, covering not less than 4 to 6 weeks. Experience in this direction is still too limited to decide which is therapeutically the preferable procedure. The general trend has been to concentrate the treatment as much as the patient's tolerance will permit. According to Cameron's observations, it is possible with the 2 gram pack to supply 120,000 milligram hours to the tumor outskirts, for example, in the course of 1 week without causing any serious epidermicidal reaction. There are very few untoward symptoms excepting a transitory nausea. This session is not undertaken until about 1 month has elapsed after the intrapelvic treatment, and is not repeated before another month.

The crossfiring of the invaded territories can be carried out by means of high voltage X-rays instead of the γ-rays from the radium pack when this is not available. It must be sufficiently

diffuse and intensive to attain complete catalysis of the cancer before much time has elapsed and widespread sclerosis appears. For this reason the extrapelvic treatment should be as concentrated as the individual's tolerance will permit. At the New York City Cancer Institute, I. Levin distributed the individual treatments with high voltage X-ray through a period of 6 weeks, while I. Kaplan gives as many as two treatments a day thus attaining a skin erythema depth dose within 1 week. With proper attention directed toward the protection of other organs, such as the spleen and the adrenals, the pelvis itself may safely receive very intensive X-ray treatments. By the correct choice of fields and their alternation, together with the expedient of crossfiring, the proper depth dose is given without damage to the surface. The initial radiation cellulitis and peritonitis as well as the ultimate extensive pelvic sclerosis can be seen when, for some cause, the abdomen has to be opened after the patient has been subjected to a serial deep X-ray treatment. How much still viable cancer remains in this sclerotic mass cannot be estimated. If at some time a latent cancer cell shall assert itself, remains in doubt. A portion of the outlying parametrium has not been effectively reached by the γ-rays in the *intrapelvic* treatment with radium. The span to be traveled is only 6 to 6.5 centimeters from the uterine axis to the pelvic wall. The reason is not the lack of penetration by the γ-ray which is not fully absorbed until it has passed through about 20 centimeters of soft tissue. It is due to the divergence of the rays which occurs very rapidly and is inversely proportional to the square of the distance from its uterine or vaginal source.

The fields for the portals of entry are chosen low in each iliac region and over the right and left gluteal region, below the level of the sacral promontory. In the obese, the gluteal fat may necessitate the shifting of the posterior fields toward the sacrum. The passage of the rays is considerably impeded by larger masses of fat or the bony structure of the true pelvis. The X-ray equipment which is generally employed in radiography, is unsuitable for cancer therapy. The four machines in use at the Cancer Institute each have a capacity of about 200,000 volts and the average voltage used varies between 130,000 and 180,000 (D. Ehrlich). The aim is to apply only shorter wave length X-rays which are capable of greater permeation and are not largely absorbed before the tumor district is reached.

For the γ-rays of radium, on the contrary, fatty tissue, or bone offers very little hindrance to penetration and with proper filtration there are few soft rays absorbed on the way to the neoplastic area upon which the crossfiring is focused. In order to produce X-rays of the same hardness and short wave length as the γ-ray, it would require a generator with a capacity of 500,000 to 2,000,000 volts (C. H. Viol).

In radiotherapy it has been a matter of general experience that the types of growth which possess the greater degree of biological malignancy are also more radiosensitive, perhaps because of the outstanding action of radium on mitosis upon which biological malignancy in a great measure depends.

Those tumors should, therefore, naturally be more radioresistant which are less anaplastic and show better differentiation and in which mitosis and cell division recede as the differentiation or specialization of cells in the tumor proceeds.

Of the epidermoid cervical growths, the epithelioma with prickle cells and cornification extends into the broad ligament more slowly than the other types and is, from the surgical point of view, the most benign of all cancerous growths of the cervix and, at the same time, relatively the most recalcitrant to the influence of radiation.

There are 4 rather well characterized clinical phases of the cervical lesion after radium treatment. In the smaller exophytic lesions, the dusky red and relatively glossless, mammillated tumor contrasts in sharp outline with the smooth uninvolved portion of the hyperæmic exocervix. The fine red lines of overfilled vessels indicate that the radium has had its effect. The young cancerous patch or nodule or ulcer is usually excentric in its location; it involves only one lip of the cervix or its angle, or the surface lesion already may have reached the vaginal junction as is likely to be the case in the more common epidermoid type of the growth. What is going on within the healthy environment under the action of the radium is nothing more than a histological and physiological expression of defense, for this is what an exudative inflammation really means.

The molecular disturbance caused by the γ-ray in the tumor itself, stops the process of mitosis on which cell multiplication depends. There is a stasis of the interfilar fluid in the cell, the cell body swells. The cytolysis which is going on shows itself by vacuolization in the nucleus and protoplasm. The cell outline becomes indefinite, the staining properties and chemical reaction change, the nucleus breaks up and undergoes dissolution.

In the clinical phase there is at first apparent hyperæmia and capillary injection of the surface around the growth. In the course of 1 or 2 weeks,

evidence of surface necrosis is seen with the formation of a greenish slough. According to the extent, it takes 2 or 3 weeks more for the slough to separate so that it can be cast off, and expurgation is accomplished. Sometimes the slough is tardy in demarcating and may linger until the sixth or eighth week. Finally the defect, in expurgated areas on the surface as well as in the deeper strata, heals by granulation and scar formation according to the same unalterable laws that dominate the healing of wounds generally.

The changes that are brought about in the pelvis by radiation are extensive. In essence they are primarily due to an aseptic exudative inflammation in the peritoneum and cellular tissue, with hyperæmia and lymphostasis. Wherever cancer deposits are disintegrating, the leucocytes permeate the structures in large aggregations. The massive dosage dealt to the cancerous growth has also temporarily devitalized many healthy cells. This, together with the widespread stagnation of the tissue fluids that exists, makes the situation peculiarly serious in infection. An operation should therefore never be undertaken a few days after radiation.

In the course of 10 to 14 days, the radiation peritonitis has become subacute, the healthy tissues in the pelvis, and the patient herself have had time to recover. However, before the inaugurated transformation has entirely ceased, particularly in the connective tissues, months or even a year may elapse. The surgeon meets with firm adhesions in the pelvis and hard fibrous or leathery masses replace the loose cellular tissue between the broad and sacro-uterine ligaments and the base of the bladder, and encumber the execution of an extended operation.

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THE TREATMENT OF INTRACAPSULAR FRACTURE OF THE HIP JOINT

By the Method of Extension, Abduction, and Internal Rotation (Whitman's Method), with Especial Reference to the Group Age, Sixty and Beyond

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THE Orthopædic Division of the Mount Sinai Hospital of Cleveland, Ohio, a general hospital of 290 beds situated in a thickly populated part of a large industrial city, has had full charge of the fracture service for the past 14 years. The staff members have had under their care a sufficient number of cases of intracapsular fracture of the hip joint, which, with the exception of 5 cases, have been invariably treated by the method of "extension, abduction, and internal rotation" (Whitman method), to warrant as comprehensive as possible a review of the results secured. The following compilation is the result of this checkup. No case is tabulated unless it has been examined by a member of the orthopedic staff of the hospital or dispensary, at least *2 years after discharge* from treatment.

We were fearful at first that, because of the large number of patients who had died, who could not be found, or who refused re-examination, the number herein reported might not be a true cross section of the work done (119 in all). However, we know that the tabulation in Group 2 (cases from 40 to 50 years) is an accurate and true picture of all the cases of fracture of the small part of the neck of the femur that we have had in this age group in these 14 years. We also believe that the report on the age group from 70 years upward (which includes less than one-half of the total number of cases), represents a rather true picture. We, therefore, do not hesitate to present our final figures as a rather fair summary of the entire group with which we have had to deal.

The preponderance of females over males, practically 3 to 1, is striking, especially when one takes into consideration the fact that men are more likely to be exposed to injury.

In all patients below 40 years of age the fractures united. This was also true of the entire group of unchecked cases, which were rather few in number and could easily be remembered as no difficulty was experienced in treating them.

In Group 2, patients from 40 to 50 years of age, we found our most disappointing results. A careful review of the histories showed that in some instances the fractures had been produced by a minimum amount of violence due to the fact probably that many in this group were asthenic individuals in poor general health or were suffering from general systemic disorders. It is our belief that if the hip bones are absolutely normal, they do not readily fracture in patients from 40 to 50 years of age, but that more commonly the acetabulum may be fractured, or there may be a central dislocation, or intra-trochanteric fracture. The fact that in 2 cases of non-union luetic osteoarthropathy was found attests to the fact that in some of these cases there was a predisposition to non-union caused by a pre-existing lowered resistance in the region of the neck of the femur, which obviously rendered the healing of the fracture more difficult.

In Group 3, patients from 50 to 60 years of age, the results of this treatment were most gratifying, with 13, or 87 per cent, of union and 2, or 13 per cent, non-unions. Although this group falls within the age range in which fracture of the neck of the femur is most prevalent, the large number securing union may be attributed to the fact that in most instances patients at *this age* possess better vitality and recuperative power. It is also interesting to note that all the male patients in this group, 3 in number, obtained union and good end-results.

In the group of patients more than 70 years of age, the favorable results, we believe, are due to the fact that most of the patients were thin and wiry, and in robust health. Less fortunate patients in this group either died or secured no union. The patients treated primarily with the Bradford traction abduction brace showed the highest percentage of union—1 death and 3 with union. However, the number of cases is altogether too small from which to draw any conclusions, and the brace was used only to meet special conditions when it was not possible to use the Whitman cast.

In the entire series of cases the method of treatment has been fairly uniform. In all except 5 cases the Whitman abduction method was used and in most of the cases Bradford abduction or Thomas walking splint was later applied. From the data tabulated, it would appear that the splints—Thomas or Bradford abduction—are

GROUP 1.—UP TO 39 YEARS OF AGE—9 CASES

Name]	Sex Age	Treatment	Result	Remarks
F. B.	M 8	Whitman abduction cast 6 wks.	Perfect	Walked on crutches with cast after third week.
M. J. M.	M 12	Whitman cast 3 mos.	Union with coxa vara	Subtrochanteric osteotomy 6 yrs. later, 1 inch shortening.
R. G.	M 14	Whitman cast 3 mos.	Perfect	
G. C.	M 27	Whitman cast 3 mos.	Perfect	
R. L.	M 29	Whitman cast 3 mos.	½ inch shortening. Union with mild flexion adduction deformity	Associated with tearing of external lateral ligament of knee.
M. F.	F 36	Whitman cast 3 mos.	Perfect.	
L. G.	M 37	Whitman cast 3 mos., brace 3 mos. (Bradford-abduction)	Moderate coxa vara with 1 inch shortening union	No disability.
L. M.	F 38	Whitman cast 3 mos.	Moderate coxa vara with 1 inch shortening	4 plus Wassermann.
L. P.	F 39	Whitman cast 2 mos.	Perfect union	No limp or shortening.

SUMMARY OF GROUP 1.

	Cases	Per cent		Cases	Per cent
Mortality	0	0	Severe deformity	1	11
Non-union	0	0	Complications	0	0
Union	9	100	Male	6	66
Mild deformity	4	45	Female	3	33

GROUP 2.—40 TO 50 YEARS OF AGE—10 CASES

K. K.	F 47	Whitman cast 3 wks.	Union 1 inch shortening mild coxa vara	Cast removed by husband after three weeks.
A. G.	F 48	Whitman cast 3 mos.	Non-union.	
A. K.	M 48	Whitman cast 3 mos.	Non-union	Developed Charcot joint, slipped while bowling.
A. S.	M 49	Whitman cast 3 mos., Bradford abduction splint 12 mos.	Non-union	Developed Charcot joint, fractured while swinging at golf ball.
A. F.	F 49	Whitman cast 3 mos.	Non-union.	
M. T.	F 50	Whitman cast 3 mos., Thomas walking splint 6 mos.	Non-union	Fracture occurred by twisting hip.
C. G.	F 50	Whitman cast 3 mos.	Union, ½ inch shortening.	
I. F.	F 49	Whitman cast 3 mos.	Non-union	Bone graft after one year, union 1½ inch shortening.
O. B.	M 49	Whitman cast 3 wks.	Non-union	Cast removed because of pneumonia, Bradford brace refused.
N. H.	F	Whitman cast 3 mos.	Union, ½ inch shortening.	

SUMMARY OF GROUP 2.

	Cases	Per cent		Cases	Per cent
Mortality	0	0	Severe deformity	0	0
Non-union	7	70	Complications	3	30†
Union	3	30	Male	3	30
Mild deformity	2	66*	Female	7	70

*Of cured cases.

†2 Charcot joints, 1 pneumonia.

GROUP 3.—51 TO 60 YEARS OF AGE—15 CASES

Name	Sex Age	Treatment	Result	Remarks
Mrs. H.	F 51	Whitman cast 3 mos.	Union, 1-inch shortening.	
E. Z.	F 52	Whitman cast 3 mos.	Non-union.	
E. M.	F 52	Whitman cast 3 mos.	Union.	
Mrs. G.	F 52	Whitman cast 3 mos.	½-inch shortening, union.	
R. M. C.	F 53	Whitman cast 3 mos.	1-inch shortening, external rotation, union	Died 1 year later of uræmia.
S. W.	F 54	Whitman cast 3 mos., Thos. walking splint 6 mos.	1-inch shortening, external rotation, union	Walks well.
H. H.	F 55	Whitman cast 3 mos., Thomas splint	Non-union	Albee graft, non-union. Whitman reconstruction operation 9 months later with good result.
H. K.	M 55	Whitman cast 3 mos.	Union, ½-inch shortening.	
L. R.	F 56	Whitman cast 3 mos., Thomas splint	Union, ½-inch shortening.	
H. B.	F 57	Whitman cast 3 mos., Thomas splint 6 mos.	Union. No deformity.	
M. J.	F 58	Whitman cast 3 mos., Thomas splint 6 mos.	Union, 1-inch shortening	Developed malum coxæ senilis 18 months later.
Mrs. C.	F 59	Bradford traction, abduction splint	Union. No shortening.	
S. B.	M 60	Whitman cast 10 wks.	Firm union ¾-inch shortening.	
J. O.	M 55	Whitman cast 9 wks., bed rest for 5 wks., Thomas walking splint 5 mos.	Firm union. No shortening.	
K. H.	F 60	Whitman cast 3 mos.	Union, ¾-inch shortening, coxa vara.	

SUMMARY OF GROUP 3.

	Cases	Per cent		Cases	Per cent
Mortality	0	0	Severe deformity	0	0
Non-union	2	13‡	Joint complication	1	6.5
Union	13	87	Male	3	20
Mild deformity	9	69§*	Female	12	80

‡Both females. §In slight shortening. *Of cured cases.

used principally to *protect* the *healing fracture*, to protect the weak trabeculæ from re-fracture, and to prevent formation of coxa vara, rather than to circumvent the primary causes of non-union.

A study of the cases of non-union has suggested division into two groups: first, those in which progressive destruction and absorption of the neck of the femur result in frank non-union with upward riding of the trochanter and consequent shortening and disability; second, those in which check-up X-ray examination at certain periods showed, for a period of from 3 to 9 months after the fracture, a seeming maintenance of the position obtained at reduction with no evidence of diminution in the size or contour of the neck of the femur, but with questionable evidence of callus and union, which later meant non-union. While this latter condition has been noted in some instances after the hip spica had been removed and the patient allowed to get up and about in a Bradford or Thomas walking splint, it has also been found in cases during the course of the Whitman abduction cast treatment.

Because of the peculiar blood supply of the head and neck of the femur the degree of displacement unquestionably plays an important rôle in the consequent damage to blood supply; the greater the displacement, the more serious the damage to the blood supply. It is conceivable that in cases of a more or less complete isolation of the head and proximal portion of the neck, particularly in old and debilitated patients, no form of fixation, however long continued, would result in union.

On the other hand, in cases with little or no displacement, or a minimal damage to the blood supply, it would seem that union would more likely result. This factor could not be checked up properly on account of the practice of destroying X-ray plates more than 5 years old, and because of a recent local movement to destroy all inflammable films in the X-ray laboratories of our city.

As to the method of treatment, the almost miraculous relief from pain and the ease with which we could handle these patients when the

GROUP 4.—61 TO 70 YEARS OF AGE—28 CASES

Name	Sex Age	Treatment	Result	Remarks
Mrs. K.	F 63	Whitman cast 3 mos.	Union	Old infantile paralysis of other leg.
M. A.	F 64	Whitman cast 6 mos.	Non-union.	
A. R.	F 64	Whitman cast 3 mos.	Union, ¾-inch shortening.	
A. L.	F 65	Whitman cast 2 mos.	Non-union.	
B. G.	F 65	Whitman cast 4 days.		Sudden death, coronary disease.
J. P.	M 68	Whitman cast 3 mos., Thomas splint 6 mos.	Perfect union.	
Mrs. S.	F 68	Whitman cast 3 mos.	Union, ½-inch shortening.	
Mrs. B.	F 68	Whitman cast 3 mos.	Non-union	Cardiovascular renal disease.
T. W.	M 69	Whitman cast 3 mos., Thomas walking splint 6 mos.	Union.	
W. B.	F 69	Whitman cast 3 mos.	Perfect result.	
A. C.	F 69	Whitman cast 3 mos., Thomas splint 6 mos.	Non-union.	
S. B.	M 61	Whitman cast 10 wks.	Firm union. No increase of shortening	Had ankylosis of joint from childhood.
Mrs. H.	F 61	Whitman cast 3½ mos., splint 16 mos.	Union, perfect.	
M. K.	F 62	Whitman cast 3 mos., Thomas walking splint 6 mos.	Non-union.	
L. E.	F 62	Whitman cast 3 mos.	Perfect union.	
T. O.	F 62	Sand bags	Union with mild coxa vara	Impacted fracture. Developed malum coxae senilis. Death from coronary thrombosis a year later.
M. P.	F 62	Whitman cast 3 mos.	Union, ½-inch shortening.	
A. R.	F 62	Whitman cast 3 mos., walking splint 6 mos.	Non-union	Apparent union; at end of 6 months walked with crutch.
E. A.	F 63	Whitman cast 3 mos.	Non-union.	
K. H.	F 63	Whitman cast	Union, adduction deformity 1½-inch shortening	Walks with marked limp.
J. D.	F 63	Whitman cast 3 mos., walking splint	Union, ½-inch shortening.	
C. M.	F 70	Whitman cast 9 days.		Died—flu pneumonia.
A. B.	F 70	Whitman cast 3 mos., Bradford abduction walking splint 12 mos.	Union, ¾-inch shortening.	
E. H.	F 70	Whitman cast 3 mos., splint 6 mos.	Non-union.	
I. E.	F 70	Whitman cast 3 mos., splint 6 mos.	Union, ¾-inch shortening.	
J. H.	F 70	Whitman cast 3 mos.	Non-union	Three other fractures of long bones.
Mrs. H.	F 68	Whitman cast 3 mos.	Union.	
J. T.	F 65	Whitman cast 3 mos., Bradford abduction brace	Union.	No shortening.

SUMMARY OF GROUP 4.

	Cases	Per cent		Cases	Per cent
Mortality	2	7	Non-union complicated	2	...
Non-union	9	32	Other fractures	3	...
Union	17	68	Male	5	18
Mild deformity	7	41*	Female	23	82
Severe deformity	1	6			

*Of cured cases.

GROUP 5.—71 YEARS OF AGE AND MORE—17 CASES

Name	Sex Age	Treatment	Result	Remarks
E. W.	M 71	Whitman cast 3 mos.	Perfect union	Some shortening.
S. K.	F 71	Whitman cast 3 mos.	Perfect union.	
M. P.	F 72	Whitman cast 3 mos., Bradford abd. splint 6 mos.	Non-union	Walks well without much limp.
Mrs. W.	F 72	Bradford Traction Abduction splint 6 mos.	Perfect union, no shortening.	
L. H.	F 73	Bradford Traction Abduction splint 3 mos.		Died cardiorenal disease, Bed sores, exhaustion.
E. McG.	F 73	Whitman cast 3 mos.	Union, no shortening.	
L. G.	F 73	Whitman cast 3 mos., Thomas splint 9 mos.	Union.	
R. H.	F 74	Whitman cast 3 mos., Brace 6 months	Perfect union.	
S. T.	M 75	Whitman cast 3 mos., splint 9 mos.	Perfect union.	
Mrs. S.	F 75	Bradford Traction Abduction Splint, 6 mos.	No shortening; union.	
L. C.	F 76	Whitman cast 1 mo., Bed rest 6 mos.	1-inch shortening, external rotation, flexion, deformity	Needs crutches.
E. W.	F 78	No treatment		Died 9 days myocarditis.
E. P.	F 78	Whitman cast		Died 8 days pneumonia.
E. S.	M 80	Whitman cast 3 mos.	½-inch shortening, firm union.	
A. F.	F 81	Bradford abduction splint 6 mos.	Non-union	Bone peg with union 3-inch shortening.
A. K.	M 84	Whitman cast 3 mos.	¾-inch shortening, union.	
A. S.	F 87	Whitman cast 2 mos.	Non-union.	

SUMMARY OF GROUP 5.

	Cases	Per cent		Cases	Per cent
Mortality	3	17.5	Severe deformity	1	9
Non-union	3	21.5	Male	4	23.5
Union	11	78.5	Female	13	76.5
Mild deformity	2	18*			

SUMMARY OF GROUPS 4 AND 5, AGES ABOVE 60 YEARS—45 CASES

	Cases	Per cent		Cases	Per cent
Mortality	5	11	Union with severe deformity	2	5
Non-union	12	30	Male	9	20.0
Union	28	70	Female	36	80.0
Union with mild deformity	9	22.5*			

*Of cured cases.

proper mechanical devices were used to lift them, were so startling and pronounced that we shall continue with this practice unless it can be shown by preponderance of evidence that results from some other method are far superior to ours.

In our experience, the diagnosis of intracapsular fracture is not difficult. Any person above the age of 55 years who falls down and is not able to arise and walk, who has shortening and external rotation, who is not paralyzed, and whose foot, leg, or thigh is not fractured, has an intracapsular fracture of the hip. Diagnosis can be readily verified at once by an X-ray examination.

A general anæsthetic is usually not necessary, as local or spinal anæsthesia is almost always satisfactory. The usual stiffening of the knee joint can be prevented by incorporating ring locks into the cast at the knee, the plaster being cut away here so that the knee can be exercised at the end of the sixth week. If a plaster cast cannot be used the patient can be fitted with a Bradford extension abduction splint after the classical manner recommended by Bradford in his final paper in the *American Journal of Bone and Joint Surgery*, and the final result will in no way be impaired.

EMPYEMA IN CHILDREN

GEORGE B. PACKARD, JR., M.D., DENVER, COLORADO

OBSERVATIONS on the following series of 64 consecutive cases of empyema in children and infants bring out certain conclusions that seem worthy of discussion. Consideration has been limited to surgical treatment and prognosis.

Empyema in an infant or a young child is to be considered somewhat differently from that in an adult. The vital capacity in a young child is so small that a moderate collection of pus or a fair sized pneumothorax seriously interferes with proper oxygenation and the latter in particular can easily lead to a fatal asphyxia. Then too the mediastinal structures forming a septum between the right and left chests are very lax in the child so that an influx of air into one chest causing collapse of that lung will push over the mediastinum and seriously embarrass the opposite lung and the circulation. It is probable too that early adhesions in a child are even more delicate than in the adult and are much more easily ruptured with wide lung collapse if much pressure is brought to bear on a walled-off area.

MORTALITY

Mortality rates for children given from different clinics vary tremendously. The variation depends somewhat upon whether only operated upon cases are figured or all cases including those too nearly moribund to allow surgery. A few have been selected as typical examples.

L. E. Holt, New York Babies Hospital, 127 cases up to 2 years of age, 65 per cent mortality.

Brown, Children's Hospital of Philadelphia, 259 cases up to 8 years of age, 26.2 per cent mortality.

Spence, Babies Hospital of New York, 177 cases up to 3 years of age, 44.6 per cent mortality; under 2 years of age, 60 per cent mortality.

Ladd and Cutler, Boston Children's Hospital, 268 cases, 17 per cent mortality; under 2 years, 35 per cent mortality.

Pybus, London Hospital for Sick Children, 100 operated upon cases, 24 per cent mortality.

Comby, Paris, 107 cases up to 5 years of age, 54.2 per cent mortality.

Farr and Levine, New York St. Marys and New York Hospital, 359 treated cases, 20 per cent mortality.

McEnery and Brenneman, Children's Memorial Hospital, Chicago, 37 cases treated by aspiration, 12 per cent mortality.

In our series of 64 cases, treated at the Denver Children's, the Colorado General, and the Denver County Hospitals, the oldest child was 15 years of age. I have not included in this series a few cases in which no surgical treatment was given due to the condition of the patients and a few cases found by autopsy to have empyema. However, patients treated by only one aspiration are included.

In the 64 cases, there were 4 deaths, a percentage of 6.25. Two of these deaths were in cases in which aspiration alone was done as a temporary procedure during an acute pneumonia. That leaves only 2 deaths following real operative procedure, a mortality of 3.13 per cent. The cause of death in all 4 cases was pneumonia, 1 case being complicated by otitis media and meningitis.

AGE

The oldest age in this series was 15 years, the youngest 4 months, the average being 5.8 years. There were 11 cases up to 2 years of age. The 4 deaths occurred in patients aged 5 years, 4 years, 1½ years, and 6 months which gives a mortality of over 18 per cent in the children of 2 and under, but of less than 4 per cent in the children over 2. This rapid increase in mortality as the age decreases corresponds to figures reported by other clinics.

SEX, TEMPERATURE, AND WHITE BLOOD COUNT

Two of those dying were girls, 2 were boys showing no sex preference. The average temperature at time of treatment was 101.8 degrees, varying from 99 to 104. There was nothing in the temperature of the fatal cases to distinguish them from the others. The white blood count in the 64 cases varied from 6,000 to 36,000 and averaged 18,500. The average in the fatal cases was almost the same. The lowest white count, 6,000, occurred in a fatal case, the next lowest, 9,000, made an exceptionally rapid recovery.

DURATION BEFORE OPERATION

This is apparently the most important factor of all influencing the outcome of the disease. The average duration before treatment in this series as nearly as could be estimated was 3.5 weeks, and varied from 3 days to 7 months. The fatal cases were treated an average of 5 days after onset, 19 days under the average. These figures make a

most powerful argument against early operation even though two of these cases were treated by aspiration alone. Wilensky reported a lessening of mortality with each week that operation was deferred up to the seventh and eighth week from the beginning of the disease, after which the mortality showed a rapid rise. Most clinics realize now the value of delay and the old plan of early diagnosis and emergency operation has been completely discarded. The terrific mortality figures given by writers only a few years ago are probably largely the result of early operative treatment. Whenever possible, no operation should be done until the active pneumonia has completely subsided. If it is feared the patient is suffering from fluid pressure or toxic absorption, aspiration alone in moderate amounts should be practiced until the lung is clear of consolidation.

CHARACTER OF PUS

Closely related to the duration of the empyema before treatment is the character of the pus found at operation. Of the cases noted in this series, the pus was thick in all but six. In these the fluid was described as thin, slightly cloudy or turbid. It is of greatest significance that in 3 of my 4 deaths, the fluid obtained was thin. It is a good rule never to operate upon an empyema until the fluid becomes frankly purulent—not cloudy, not showing pus by microscope but grossly of a milky or creamy consistency. Aspiration of small amounts of clear fluid is permissible if pressure seems severe.

AMOUNT OF PUS

The amounts noted varied from 5 cubic centimeters to over 1,500 cubic centimeters and averaged 315. The amounts in this series seemed to bear no relation to the mortality and I do not believe should influence treatment except that removal of too large amounts at one time seems to raise temperature and cause other toxic symptoms, perhaps due to undue pull on a collapsed lung.

METHODS OF TREATMENT

While the great majority of these cases were treated by a closed method of drainage, there were enough open drainage cases and aspirations to consider some comparisons. Treatment was instituted as follows: in 4 cases aspiration, in 10 rib resection or open intercostal drainage, and in 50 closed drainage. Aspiration was used only in early cases or in cases considered too sick for greater interference. Rib resection or open intercostal drainage was used in cases of long standing encapsulation or in cases in which the pus was too thick to get out through a catheter.

Aspiration. There were 4 cases treated by aspiration alone. No antiseptic solution was used nor any washing out in these four. The previous duration of the disease was short, averaging only 7.5 days. There were 2 deaths in these 4 cases. These 2 deaths occurred in patients needled in the hope of relieving some of their toxicity. Neither death truly represents mortality from an operative procedure. The two cases surviving (not desperate cases to start with) went on to complete recovery without complication or secondary operation and remained in the hospital only a little over 2 weeks. This is not in any way a fair estimation of aspiration as a treatment. Sixteen other cases were aspirated from one to four times preceding other operative procedures and two of these had also instillation of gentian violet. Operation was done in most of the 16 cases according to our custom of operating when the pus becomes thick and the pneumonia has subsided, in the remaining cases because no progress was apparent or because it was impossible to aspirate the pus through a needle.

In fairness to the procedure, we should mention at least 3 reports in the literature. McEnery and Brenneman, in an article published in August, 1929, report 37 empyemas of children treated during the year 1928, of which 32 received aspiration alone (from 1 to 11) with 4 deaths. Infants apparently responded the best. Of some moment, however, is their note that the average hospital stay was 3½ months. Lowenburg reported 9 cases of pneumococcic empyema treated by aspiration and injection of ethylhydrocupreine. Major reported 27 cases treated by aspiration followed by injection of gentian violet, of which 14 were cured without other procedure. Five died; the average stay in hospital of successful aspirations not requiring later thoracotomy was 76 days.

Open drainage. Rib resection or open intercostal drainage was used as a primary procedure in 10 cases with one death, a mortality of 10 per cent. The average duration of the disease preceding operation was 36 days, or 12 days above the average. The one death following rib resection occurred in 1921 in a case operated upon 5 days after the onset of the empyema and was caused by extension of the active pneumonia. It is apparent that this group represents later cases with thick pus and good encapsulation. Outside complications were conspicuous by their absence. In this group, there were two secondary operations, one a separation of adhesions and the other a drainage of a subdiaphragmatic abscess. None went on to chronic empyema and healing was complete on the average in 42 days.

All these cases were irrigated two or more times a day with Dakin's solution which rapidly changed the foul purulent discharge to a clear, almost sterile, one. For these well encapsulated late cases which have survived the early dangers of toxæmia, it seems probable that good, efficient drainage helped by frequent antiseptic irrigation may give the most rapid recovery. Except for one operation, inexcusably early according to present knowledge, this group represents a more favorable class of cases than the preceding or the following.

Closed drainage. Closed drainage was performed in 50 cases with one death, giving a 2 per cent mortality. The average duration of the disease previous to operation was 3 weeks and varied from 5 to 7 months. These operations on the whole were done much earlier than in the last group. The one death followed operation to withdraw a thin cloudy fluid during active pneumonia, the patient showing steady extension of the pneumonia and dying in 2 days. Autopsy revealed double pneumonia, otitis media, and meningitis. Here again an operation was contra-indicated and hastened death.

Outside complications were numerous and consisted of meningitis, extension of pneumonia to opposite lung (2), mastoiditis (1), nephritis (3), otitis (8), endocarditis (1), chicken-pox (3), erysipelas (1), diphtheria (1), and measles (1). There were quite a few bronchial fistulas and one chronic empyema. The average duration of drainage for these closed cases was 46.1 days which included 3 long cases, respectively 180, 190, and 330 days. This duration is 4 days higher than the rib resection and can probably be explained by the poorer condition of the patients and the greater number of complications. It has been repeatedly noticed that an empyema, no matter how drained, will not heal in a patient who is sick or debilitated from other cause.

Some secondary operations were required. There were 5 requiring rib resection because of unsatisfactory drainage due either to pocketing or very thick exudate. There were also 5 reinsertions of the closed drainage tube after too early a removal. This latter can hardly be called a secondary operation. There was one decortication for chronic empyema 3 months after the secondary rib resection and resulted in a cure. There are no chronic cases now persisting.

A few words should be said about this technique. A No. 14F, or No. 16F, catheter with an open end and 2 side fenestrations is used. This is inserted under local anæsthesia by the trocar cannula method, the largest tube that will go through the cannula being used so as to give an air tight fit in the chest wall. A length of 2 or 3 inches is allowed inside the chest. There is no necessity for dependent drainage, though the tube is usually put into the lower part of the cavity. The greatest care is taken not to allow any air to enter the chest during the treatment. The pus is removed gradually, attempt not being made to remove all at time of operation unless the total amount is small. If the patient begins to cough during withdrawal of pus, normal saline is injected until the annoying irritation has stopped. It usually takes about 48 hours before all the original pus is withdrawn. From then on we use some form of suction and irrigation. Usually the cavity is irrigated two or three times in 24 hours with Dakin's solution until the fluid returns clear. In addition to these irrigations, the usual plan is to instill a small amount of Dakin's solution every 3 hours, first withdrawing the accumulated secretion. Suction is kept up by this frequent aspiration of the secretion with clamping of the tube while pressure is still negative or by connecting the drainage catheter to a long tube full of water running into a half-filled bottle on the floor, the latter giving a constant pull equal to the weight of the column of fluid reaching from the bed to the floor. The aim in this treatment is first, to keep up a constant negative pressure and consequent pull upon the lung and second, to keep the slowly shrinking cavity continually bathed in Dakin's solution which not only destroys organisms but also gradually dissolves thickened secretion and fibrin. The element of suction, of course, is lost when bronchial fistula is present. There is no absolute rule to tell when a tube may be removed. The patient should be in good condition, the drainage must be practically clear, and success is most likely if the cavity holds one-half ounce or less. I have not recently used the microscopic bacterial count.

This method sounds a little simpler than it really is. There is often great difficulty in getting this pus out through a catheter in the early stages and for the first few days one must sometimes give freely of time and patience. It is practically impossible to leave these cases to an interne or nurse unless carefully watched because through inexperience or lack of time they will fail to keep these tubes running freely and frequently leave in the chest more of Dakin's solution than they remove of secretion. One nurse experienced in this form of treatment is of inestimable value. This difficulty was present in only a few of the cases. The others gave no trouble at all and very few of the cases were hard to manage after the first week.

CONCLUSIONS

The mortality of 6.25 per cent is extremely low, one of the lowest reported. Of course, it must be remembered that the mortality of empyema is the mortality of the accompanying pneumonia and of its complications. As we are reporting here only treated cases of empyema, the great majority are those that have survived the pneumonia, so consequently many of the fatal cases reported in some statistics do not fall in this category.

The greatest single factor influencing mortality was the time of operation—no case died that was operated upon after the pneumonia had subsided and the pus had become thick. Apparently greater operative interference than aspiration is inexcusable in the presence of pneumonia, and even then aspiration should be done only for pressure.

Age will always remain a factor in the mortality, the younger the patients are up to 3 years, the higher the number of deaths. Temperature and white blood count should not be considered as of prognostic importance.

As to the type of operation, this series is too nearly a series of closed drainage to give a good comparison of the three types. Certain impressions may be worth mentioning.

Aspirations are of greatest value in removing early fluid which causes embarrassment from pressure. It is more likely to be curative in small effusions, particularly in infants. If cure is not apparent after two or three aspirations, I believe time and probably risk are lessened by establishing better drainage.

Open drainage or rib resection undoubtedly gives the most efficient evacuation of pus when accompanied by irrigations. The frequent washing out of these cavities with Dakin's solution cannot fail to help the mechanical drainage tremendously besides having an antiseptic and solvent action on the secreting membrane. The objection to open drainage is, of course, lung collapse, and it should be saved for late cases, preferably moderate sized cavities with encapsulation. In the late cases with tremendous effusion, primary closed drainage for a period will allow some lung expansion and encapsulation before rib resection.

Closed drainage apparently meets its greatest indication in children. Cavities are smaller than in adults, radical operation is a greater ordeal, and, depending upon treatment, lung collapse or lung expansion occurs much more readily. A method of using negative pressure and antiseptic action theoretically offers the ideal treatment. The practical drawback is, of course, difficulty in keeping up efficient drainage the first week. If one is willing to give the time and personal attention necessary for this treatment, I believe it is the best for the average child's case. If he cannot for reasons of time or distance keep this drainage free, I would recommend aspiration longer and then dependent rib resection with irrigation.

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EDITORIALS

SURGERY, GYNECOLOGY AND OBSTETRICS

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AUGUST, 1931

THE HOSPITAL INTERNE—EMBRYO SURGEON

NO interne should expect to become a surgeon merely from the training secured during a 1 or 2 years' hospital service but that there is such a tendency is becoming increasingly apparent. Many men are limiting themselves to a one year's hospital residency before entering upon surgical practice feeling that they receive sufficient training in this brief space to justify their attempting the specialty of general operative surgery. It is obvious that such a thing is being encouraged by certain staff members who have the direct responsibility of the interne's teaching. In a recent survey it was found that 53 per cent of the internes in our American hospitals are permitted to do major surgery, the report stating that "some of the operations described would seem to require more mature skill, even though the work was performed under strict supervision. That a majority of our internes are allowed to perform major surgery, even under supervision, at first glance is surprising, if not alarming." One must agree with the opinion expressed in this report that "the idea apparently growing that internes are in hospitals primarily to acquire surgical technique and become surgeons without additional graduate preparation in that subject should be discouraged." As a distinguished teacher recently said: "the operating room serves as a laboratory in which the clinical and pathological pictures are correlated, rather than a laboratory where surgical technique is demonstrated."

A working knowledge of technical surgery is a difficult thing to acquire, necessitating much time and patience and far more experience than can be obtained in the usual few months' surgical routine of a 1 or even 2 years' rotating service and, by the same token, and what is even more important, surgical judgment is acquired only after years of practical experience. One can not train surgeons as we used to train children to swim, by throwing them into the water, but that such short cut methods are being too extensively utilized is manifested by the appalling number of unnecessary operations, which are usually badly done and on the most meager provocation or no provocation at all. Such operations are performed throughout the country largely by young men who have set themselves up as general surgeons after the most superficial and incomplete training. A serious responsibility rests on that hospital whose organization is so loosely supervised that its internes are encouraged to delude themselves into believing that they may become competent surgeons after such brief and sketchy operating experience. Such gross disregard of the welfare of the patient as well as of the good name of surgery

can not be too severely condemned. The question of badly performed and unnecessary surgery is even far more serious today than it was in 1856 when Gross said "so long as God shall give me strength, I shall not cease to raise my voice and to exert my humble influence against the indiscriminate, senseless employment of the knife so prevalent at the present day in this country."

The interne planning to go into surgery or into any major specialty for that matter requiring a high degree of technical training, manual skill, and sound judgment, should consider the 1 or even 2 years' service purely as an important and essential period of preparation before pursuing further and more intensive study in an institution dealing largely with that branch of medicine in which he is especially interested and to which he plans devoting his life, an institution in which he is prepared to devote several years of loyal apprenticeship to an older man or group of older men who, because of their long experience and proved ability are justified in being considered masters of their profession. Surgery must not be taken up lightly by the student but only after due deliberation and careful planning and then only after a firm resolve, to which he devoutly and persistently adheres, that he will never consent to perform a major operation upon a fellow human, unless in the greatest emergency, or under the closest supervision, until he has, as the result of long and thorough, self-sacrificing study, become fully competent to assume that greatest of all personal responsibilities. HAROLD L. FOSS

EMBOLECTOMY

IT has been the history of most operative procedures that once evolved, their subsequent application and the resultant evaluation of their efficacy did not become possible until the indications and type of case for which the procedure was intended, became well known. Such an operation is embolectomy for embolic occlusion of large peripheral arteries. Pemberton, in a recent article, has very aptly stated: "There is no established operative procedure of equal simplicity, fraught with so little risk, and with such dramatic potentialities that has been so woefully neglected as embolectomy for circulatory disturbances of the extremities."

In reading Scandinavian surgical literature, one is impressed by the numerous reports of successful cases of embolectomy. These have followed upon the excellent work of Key who has called to the attention of the medical public the excellent results which attend prompt surgery in arterial embolic occlusion.

The diagnosis of embolic occlusion is not difficult, especially if one has the condition in mind and if the patient has been suffering from a condition which might give rise to emboli. With the lodgment of an occluding embolus there occurs a sudden sharp pain in the affected extremity, followed by increasing difficulty in movement. On examination there is absence of pulsation in the vessels distal to the occlusion, blanching of the skin and lowered temperature.

The emboli arise from thrombus formation in the left side of the heart. Less commonly they arise from the aorta or its great branches. Factors favoring thrombosis are stasis, infection or injury to the endothelium. Stasis is probably the most frequent cause, associated with sluggish circulation in the recesses of the heart, particularly the auricles and their appendages. Such a condition exists in mitral stenosis, particularly with chronic fibrillation and dilated auricles. Thrombi may form, however, in any dilated heart, especially in the presence of congestive heart failure. Emboli frequently occur as a result

of the cardiac derangement which accompanies exophthalmic goiter, especially in the presence of auricular fibrillation. The friable, verrucous vegetations which accompany infection of the valves in endocarditis are frequently detached and thrown into the circulation. Infarction of the heart muscle, as occurs in coronary occlusion, may be followed by mural thrombi. Endothelial injury from arteriosclerosis or syphilis may give rise to emboli.

When it occurs, embolic occlusion is the occasion for prompt surgery. Its emergency nature should be emphasized. The chances of re-establishment of circulation by embolectomy are directly proportional to the time elapsed from the time of lodgment to its removal.

As mentioned previously, the successful work of Key has shown that the occasions for the use of the operation are more frequent than has been apparent in this country. When the indications for its employment are well known and its emergency nature understood, there is little doubt but that it will be the means of saving many limbs of which amputation would otherwise be inevitable.

ROBERT L. MASON.

MEMOIRS

JOHN OSBORN POLAK

Born March 12, 1870—Died June 29, 1931

IN the passing of John Osborn Polak the American College of Surgeons shares with the medical world the loss of one of the great gynecologists and obstetricians of our day. He was a Founder and Life Member of the College, a Governor 1913–16 and 1926–31, and a Regent since 1927.

During eighteen years, since the organization of the College, he was active in its work. He aided in formulating its ideals, in its vision and support of the scientific specialist in surgery, in its effort to better the environment of surgical practice, in its practical research, and in its stand for ethical transactions among physicians and surgeons.

Doctor Polak was wise in counsel, and he was uncompromisingly for safe administration. He was an ardent supporter of our partnership with the public, and ungrudgingly gave of his time at our annual congresses, and at our numerous sectional meetings throughout the United States and Canada, so many of which he attended.

The officers, Regents, and administrators of the College will miss his friendly greeting, his companionable spirit, and his staunch advocacy of those things that are right.

This friend, so suddenly and prematurely taken away, was ever loyal to the past, confident of the present, and trustful for the future. He possessed great strength of character, and many fine human attributes. It is difficult to realize that our personal friendship of many years has ended. FRANKLIN H. MARTIN.

DOCTOR POLAK was born in Brooklyn, New York, home of four generations of his family, on March 12, 1870, the son of Karl T. and Mary E. (Osborn) Polak. In 1896, he married Bertha L. Pitkin, of Brooklyn, who died in 1924. There is one daughter, Mary Osborn Polak.

He received his early education in the public schools of New Brunswick; B.Sc., Rutgers College, in 1889; M.D., Long Island College Hospital and University of Vermont, 1891, at which time he received the Dudley Medal for Surgery; M.Sc.,

Rutgers, 1901; interne, Long Island College Hospital, 1891–92; resident, Midwifery Department, New York Postgraduate, 1892–93; instructor in histology and obstetrics, Long Island College, 1892–95; instructor in obstetrics, New York Postgraduate, 1894–98; adjunct professor, 1898–1901; professor of obstetrics, 1901–7; assistant professor of obstetrics and gynecology, Long Island College, 1900–1910.

In 1902, he succeeded the late Dr. Paul Munde as professor of obstetrics and clinical professor of gynecology, Dartmouth Medical School, serving for ten years. He succeeded the late Dr. Charles Jewett as professor in the department of obstetrics and gynecology in the Medical School of Long Island College Hospital, in 1912, and on March 26 last was elected president of the Board of Regents of the hospital; chief obstetrician and gynecologist, Long Island College Hospital, 1911; attending gynecologist, Williamsburgh Hospital, 1894–1906; Brooklyn E. D. Hospital, 1896–98; Jewish Hospital, Brooklyn, 1906–22; Deaconess Hospital, 1899–1907; People's Hospital, New York, 1909–12; chief, gynecological department, Polhemus Clinic, 1899–1910; obstetrician, Methodist Episcopal Hospital, 1906–14; director, department of obstetrics and gynecology, Israel-Zion Hospital, 1924–29; consulting gynecologist, Jewish Israel-Zion, Caledonian, Bushwick, Coney Island, and Southampton Hospitals; consulting obstetrician, Methodist Episcopal, Mary Hitchcock, and Nyack Hospitals.

Fellow, Royal Academy of Medicine (Ireland); member, American Gynecological Society (councilor, 1921; vice-president, 1924), American Association of Obstetricians, Gynecologists and Abdominal Surgeons (president, 1927), New York Obstetrical Society (president, 1916), Brooklyn Gynecological Society (president, 1910), American Medical Association (chairman, section on obstetrics, 1921), New York Academy of Medicine, New York State Medical Society, Medical Society County of Kings (president, 1915), Long Island Medical Society, Associated Physicians of Long Island, Brooklyn Medical Society, Williamsburgh Medical Society, Brooklyn Pathological Society.

Collaborator, Keating and Coes Gynecology, 1894; and Text Book of Obstetrics by American authors, 1906; author, Manual of Obstetrics, 1913 and 1922; Students' Manual of Gynecology, 1915, 1922, and 1927; Pelvic Inflammation in Women, 1921 and 1931. Also author of many scientific articles pertaining to original work in his specialties.

Editor, Department of Obstetrics, INTERNATIONAL ABSTRACT OF SURGERY; member, Editorial Boards of the *American Journal of Surgery* and the *American Journal of Obstetrics and Gynecology;* and chairman of the Sub-committee on Parental, Maternal, and Early Infant Care, of the White House Conference on Child Health and Protection.

THE SURGEON'S LIBRARY

OLD MASTERPIECES IN SURGERY

ALFRED BROWN, M.D., F.A.C.S., OMAHA

THE SURGERIES OF CHARETANUS

BY no means the least interesting of the old surgical works are those that we know little or really next to nothing about. Perhaps as surgical milestones they may not be particularly important. Perhaps here and there they may contain a bit of surgical knowledge or procedure which is new for the time. Perhaps they may contain a bit of the art of medicine which may be a little quaint or ingenious as showing the author's canniness; in one of these books of Charetanus is given a valuable recipe by the use of which one may lengthen his life fifteen years but then is added "if it is not against the will of God." The authors of many of these interesting books are not well known. In fact we know and can find out little about them. Consequently they represent a question mark in history which leads to a puzzle which is at least alluring to the student of surgical history.

The surgeries of Charetanus appeared during the second quarter of the sixteenth century. They are small books of only a few pages and appeared in several forms. One, according to Gurlt, was printed in Strassburg in 1530 and later reprinted in Frankfurt in 1549 and 1552. It bears as its title "Wound Surgery: for all wounds of the entire body, and especially of each member, with what may occur and is necessary for the wound surgeon to know. Many excellent prescribed medicines, advices, and masterpieces of the very learned surgeon Joannus Charetanus. The correct art and instruction for bloodletting. For the bloodletter and barber." A second printing of this work by H. Guelfferich appeared in 1549, and a later edition enlarged to thirty-six pages appeared in 1552. An edition bearing practically the same title but differing in arrangement of material and illustrations was printed by Chr. Egenolph in 1531. On the title page it reads "Zu Strassburg. Chr. Eg." and at the end the colophon reads "Zu Frankfort im Jenner/des iars 1531," so whether printed in Strassburg or Frankfurt it is hard to say. A third form, noted by Gurlt, was printed by Chr. Egenolph, at Frankfurt am Meyn in 1534 and the names of Lanfrancus and Laurentius Fries are added to the title.

This series of surgeries represents the first surgeries printed in German after the works of Jerome of Brunswick and Hans von Gerssdorff in the latter part of the 15th and early part of the 16th centuries and the work of Fries, more medical than surgical, which was first printed in 1518. As to the author, Johannus Charetanus little is known of him under that name. A man named Johannes de Karthan natione almanus is referred to by Champier in his *De medicine claris scriptoribus* which gives a clue to a German named Karthan who practised surgery. Sudhoff in his *Ketham* (Monumenta Medica, Sigerist, R. Lier & Co. 1923) refers to this Johannes Karthan and believes the name, which was spelled in many forms—Karthan, Karchan, Kartham, etc., were variants of the name of Johannes of Kirchaim, a physician and surgeon of the latter half of the fifteenth century who was professor of medicine and surgery at the University of Vienna. The name of this man was also spelled Kirchheimer. From Karthan to Charetanus is not a very long jump when one considers the many variant spellings in vogue when this man lived and the translation of the name from the vernacular into Latin. Especially when it is rather assumed that this man Johannes of Kirchheim was probably also known as Johannes de Ketham, the author of the *Fasciculus Medicine*, Venice 1491. The likelihood that three names, Ketham, Kirchheim, and Charetanus were used for the same man is the fact that certain parts of the surgical sections of these small surgeries of Charetanus of the sixteenth century correspond identically with similar corresponding sections in the *Fasciculus Medicinae* of Johannes de Ketham of the fifteenth century, the later German text being a translation of the earlier Latin.

The most interesting parts of these small surgeries are the illustrations which differ in the two editions. In the edition of 1539, the title page shows some dental instruments and the cuts are reproduced later in the part of the book dealing with that subject. The main illustration is a slightly altered woodcut of the bloodletting mannikin of Fries which is carefully labelled "Contrafacter-Lassman," to let every one understand that the dissection represents the body of a criminal. There is also a smaller cut of a zodiac man showing the trunk dissected. In the 1531 edition the man of Fries is omitted and is replaced by a smaller different cut and a woodcut of a physician performing uroscopy is added.

Together, these works of Charetanus give an excellent idea of the character of the popular small surgical textbook of the early sixteenth century.

Wundartzney:

Zů allen Gebrechen des gantzen Leibs/ Vnd zů iedem Glid beſonder/ Mit was zůfällen die entſtehn/ Vnnd eim Wundartzt zůkomen mögen. Vil edler/ bewärter Artzneien/ Rath vnnd Meyſterſtuck. Des vil erfarnen Chirurgen IOANNIS CHARETANI.

Rechte Kunſt vnd Bericht der Aderläß.

Für die Aderläſſer vnd Scherer.

Zu Straßburg. Chr. Eg.

REVIEWS OF NEW BOOKS

THE great problem confronting the medical profession today is the control of cancer. In this connection, the recent report from the Liverpool Medical Research Organization[1] relative to the cancer problem is food for thought for the skeptic as well as for the believer. Here is assembled a tremendous amount of material which applies directly to this vital subject. The work was begun almost 30 years ago under the auspices of the Liverpool Cancer Committee and has been continued with the Liverpool Medical Research Committee.

The morphological, physicochemical, and physiological evidence of similarity between the chorionic epithelium and malignant neoplasms is presented and to the unbiased mind there certainly is evidence that warrants further study and thought.

The action of lead and other metals on normal animal and vegetable growth was studied on an extensive scale because it was discovered that lead causes abortion by coagulation necrosis of the chorionic epithelium without injury to other tissues if the amount of lead is not too great. It has been shown further that lead has the power to inhibit growth temporarily when rootlets or aquatic animals are immersed in weak solution for a short time, but of causing complete inhibition when there is prolonged contact in solutions of sufficient strength.

Clinical results are recited but the authors are cautious in not expressing too optim stic a view for the present but rather an optimism for the future for they feel that a correct scheme for the solution of the cancer problem is being approached. In a series of 566 cases under observation from November, 1920, to November, 1928, 360 died before treatment could be completed (198 received less than 0.25 gram of lead and 162 received more than 0.25 gram of lead but less than 0.5 gram), 77 died of the disease after treatment was concluded, 7 died of intercurrent affections while under treatment, 5 died as result of extensive destruction of disease, 21 refused complete treatment, 31 are too recent for results to be estimated, 2 were believed to be cured but died of other affections, in 12 the disease is completely arrested, and in 51 it is believed to be cured and treatment has been stopped. Since many of these cases came under observation in an inoperable condition, many hopelessly involved with metastasis, such statistics are indeed hopeful.

For those who are interested in the cancer problem, this work is intensely interesting. Be the hypothesis and conclusions right or wrong they are backed by a tremendous amount of carefully planned experimental work, work which has been conducted along scientific lines by men of unquestionable ability and honesty. In just such a way the cancer problem will be solved. JOHN A. WOLFER.

[1] SOME ASPECTS OF THE CANCER PROBLEM; an Account of Researches into the Nature and Control of Malignant Disease Commenced in the University of Liverpool in 1905, and continued by the Liverpool Medical Research Organization (Formerly the Liverpool Cancer Committee), together with Some of the Scientific Papers that have been Published. Edited by W. Blair Bell, B.S., M.D.(Lond.), F.R.C.S.(Eng.), F.A.C.S. (Hon.). New York: William Wood and Company, 1930.

THAT a work on a subject so technical as biometry and statistics should need to be reprinted to supply the demand, and that a second edition should be justified within 10 years is proof enough both of the quality of Pearl's book[2] and of the existence of a demand. In the light of this, a review can neither add nor take much away from it.

There is some question as to just how the subject has been made attractive to physicians and surgeons, most of whom know nothing of scientific statistics and statistical methods, and not much of higher mathematics. It was for these groups that this work was assembled. The explanation is that Dr. Pearl begins with the simpler phases of the subjects treated and passes progressively to those that are more difficult. A medical man who is moderately well grounded in mathematics can go through the book to the end with understanding and profit, provided he will do so systematically, not passing to the more technical chapters until he has digested those that go before.

The earlier chapters deal with simpler phases of bionomics and statistics. They are entertainingly written and can be followed without much use of pad and pencil. Gradually the subjects treated become more technical and a different method of presentation is employed. The physician who stays through will find himself refreshing his memory of the mathematics of his college days to his own advantage.

Nearly every physician and surgeon who writes makes some use of statistics. He should know at least the rudiments of the science if he is to make his presentation accurate, understandable, and convincing. Dr. Pearl has extended his discrimination to an evaluated bibliography, a section of which follows each chapter. W. A. EVANS.

[2] INTRODUCTION TO MEDICAL BIOMETRY AND STATISTICS. By Raymond Pearl. 2d rev. ed. Philadelphia and London: W. B. Saunders Company, 1930.

THE *Ergebnisse der medizinischen Strahlenforschung*[3] is a collection of monographs, each of which is written by a recognized authority in his particular field. The fourth volume contains many subjects especially valuable to surgeons and surgical specialists.

Luedin writes on the changes in position and shape of the stomach which result from extraventricular causes and illustrates his discussion with excellent roentgenograms. Schule discusses the clinical and roentgenographic findings of the ureters and kidney

[3] ERGEBNISSE DER MEDIZINISCHEN STRAHLENFORSCHUNG (Roentgendiagnostik, Roentgen-, und Lichttherapie). Vol. IV. Edited by H. Holfelder, H. Holthusen, O. Juengling, H. Martius, and H. R. Schinz. Leipzig: Georg Thieme, 1931.

in relation to the differential diagnosis of abdominal tumors. Schmidt writes on the relation of the cellular histology of uterine carcinomata to irradiation therapy and discusses the various stages of reaction which are essentially phagocytic and lytic processes. Lahm discusses very fully the foundation of biologic healing of cancers. Meyer and Schmidt consider the stomach after operation and discuss the anatomy and physiology, the relation of surgical attack on these functions, the technique of diagnosis, the various methods of operations, and the undesired results of operations. Luedecke presents a short monogram on the use of diathermy in oral, rhinal, and laryngeal diseases, discussing the physics of diathermy and describing the apparatus and technique of medical and surgical diathermy and the therapeutic indications and results.

Each monograph represents the "up to the minute" attainments in each subject. The perusal of the volume was an actual treat. HENRY SCHMITZ.

THE monograph on *Der operierte Magen*[1] deals with roentgenologic observations made by the authors in 400 postoperative gastric cases. The greater number of these were operated upon for gastroduodenal ulcer, a few for carcinoma of the stomach or for peptic-jejunal ulcer. The material came from the surgical clinic of Prof. Stich in Goettingen.

The authors stress the point that not enough attention has so far been paid to roentgenologic studies in the follow-up of postoperative gastric cases. They feel that much can be learned by early observations. They have begun their studies as early as the tenth day after operation.

The monograph deals rather extensively with the physiology of the normal gastro-intestinal tract as well as with the modifications resulting from operative interventions. Attention is paid to changes in form and position of the stomach operated upon as well as in the motor and digestive function. Practically every type of operation is included.

The authors emphasize the fact that the gastroenterostomy stoma is more than a drainage hole. Partly through cicatricial narrowing and partly through muscle hypertrophy the stoma learns to act more or less like the pylorus, so that the emptying is not continuous but is interrupted and rhythmic. They do not, however, believe that a true sphincter is formed.

In their discussion of the much dreaded early complications, such as the acute dilatation of the stomach, the so-called arteriomesenteric obstruction of the duodenum, of the vicious circle, and the paralytic ileus of the stoma, the authors advanced the view that the older conception of an actual mechanical obstruction is only exceptionally true. In their opinion the condition is most often a functional spastic one. They are in agreement with Reischauer, who first explained this phenomenon and termed it, "stomach-bowel block." The spasmodic contraction begins in the bowels and spreads to the anastomosis or to the duodenojejunal flexure.

The monograph contains much of interest to the surgeon and the roentgenologist. GEO. HALPERIN.

THE two classical works on operative gynecology —Kelly's in this country and the one by Doederlein and Kroenig in Germany—will have to look to their laurels now that the book by Peham and Amreich,[2] of Vienna, has appeared.

This volume, which by its unusual shape and size as well as by its general makeup at once creates a distinguished and favorable impression, is divided into three sections. In the first, all those factors are discussed which make for greater success of gynecological operations, namely, the routine before and after operation, prevention of infection and other postoperative complications, treatment of bleeding, technique of the various abdominal incisions, etc.

The entire second section is devoted to the topography of the contents of the female pelvis. The pelvic connective tissue which includes the loose tissues as well as the fasciæ, its relation to blood vessels and nerves, the lines of cleavage, the lymphatics, ureter, rectum, and bladder, in short, all structures that he must know who aims at proficiency in pelvic operations, are demonstrated in large colored drawings of admirable perfection. In preparing these numerous dissections the authors found that several structures which, from a purely anatomical standpoint, had no importance and carried not even specific names, were quite significant as far as operative technique was concerned.

The last and largest part of the work deals with the various gynecological operations in particular. The order of the operations described differs markedly from that in other books on operative gynecology. The operations for cancer of the uterus is given first place because it embraces practically all the details of topography and technique with which the gynecologist is concerned. Thereby the authors hoped to avoid unnecessary repetitions. It is quite clear that vaginal hysterectomy for cancer of the cervix is their favorite method, and is very comprehensively described. The abdominal radical operation is given far less space though the descriptive and pictorial representation is quite adequate.

The succeeding chapters deal with operations for fibroids, ectopic pregnancy, adnexal tumors, tuberculosis, ovarian growths, all sorts of plastic operations, etc. All these chapters are equally profusely and equally admirably illustrated.

One would need much more space than the editor is likely to allow to do full justice to this magnificent and monumental work which embodies an immense amount of hard labor, of serious and valuable research, and of attention to the minutest detail. A harsh fate carried Peham off before the book

[1] DER OPERIERTE MAGEN. By Prof. Dr. Hermann Meyer-Burgdorff and Dr. Walter Schmidt. Leipzig: Georg Thieme, 1930.

[2] GYNAEKOLOGISCHE OPERATIONSLEHRE. By Dr. H. v. Peham and Dr. J. Amreich. Berlin: S. Karger, 1930.

appeared on the market. But the record of his great achievement remains; and we must thank his pupil and co-worker Amreich for his efforts and the publisher for his munificence. GEORGE GELLHORN.

THE new German textbook of surgery dedicated to A. von Eiselsberg,[1] on his seventieth birthday, while not as large as a system in our sense is more than a textbook. It consists of two rather large volumes, the first of 869 pages, the second of 658.

The subject of surgery has apparently grown to such proportions that nothing short of a system, and that means ten or more volumes, can adequately treat it in all its phases. Among the contributors to this work, one finds such prominent surgeons and writers as von Haberer, Clairmont, Denk, and Ranzi, and a number of other and less widely known men.

Because of limited space there is a certain lack of balance. Some of the subjects have been dealt with quite extensively and impress the reviewer as fairly complete monographs, others are rather skimpy and remind one of textbook chapters.

The section on stomach, duodenum, and appendix is contributed by no lesser authority than von Haberer. It is well done and should prove of particular interest to students of gastric surgery because of the author's extensive experience in this field.

Surgery of the central and peripheral nervous systems is contributed by Marburg and Ranzi, and is excellent. It reflects all the newer ideas and advancement in this difficult field. On the other hand, surgery of the spleen is treated in nine pages. In spite of the lack of balance in the treatment of various subjects, the work is a notable contribution and a splendid tribute to the scientific accomplishments of the much revered A. von Eiselsberg.

GEO. HALPERIN.

THE present book by Hamilton Bailey, is the first of a two volume work on emergency surgery.[2] This volume deals with abdominal emergencies including injuries and diseases of the male genitalia. The book is based primarily on personal experience but has the added value in that it is liberally interspersed with references and quotations which indicate an extensive knowledge and use of surgical literature. The reviewer was somewhat surprised by the warm recommendation given to the delayed treatment for appendicitis and by the suggestion to use mercurochrome intravenously in toxic cases. It is felt that a general chapter dealing with anæsthesia in emergency surgery would be in order. It is difficult to conceive of any abdominal emergency which is not considered and, what is of more value to the reader, from first hand information. The chapters dealing with intestinal obstruction, including intussusception and hernial strangulation, are particularly well written and valuable. The conditions described and the measures advised are well illustrated by somewhat over 300 excellent illustrations. The volume contains an appendix in which are listed fourteen series of illustrative cases all from the author's practice. A well selected bibliography enhances the value of the book to the general surgeon, to whom it can be recommended.

IN a continuation and final résumé of his work on the cancer problem[3] Professor Heidenhain presents a brief working hypothesis as to the etiology of malignant tumors, as follows: lysis of human cancer cells can be induced in such a way that the supposed cancer causing agent will not be destroyed. When this product of lysis of cancer cells is injected into animals it is to be expected that tumors will be produced at a place in the body where the cancer causing agent acts, thus giving rise to carcinoma or sarcoma according to the type of tissue affected by it. The amount of labor represented in these two volumes is truly prodigious. The very mass of the evidence presented in support of the thesis commands consideration. It will fail to carry conviction to the minds of many because Professor Heidenhain used mice in his experiments. These animals are notoriously subject to the development of spontaneous tumors, far more than is any other laboratory animal. Whatever the ultimate fate of the theoretical considerations, this magnificently illustrated volume with the earlier companion volume represents a distinct contribution to the pathology of neoplasms. It is a most comprehensive and possibly definitive catalog of mouse tumors. J. P. S.

A WELL balanced picture of William Stewart Halsted, the great American surgeon, is presented by Dr. MacCallum in his recent book.[4] Halsted's medical training in this country and his postgraduate period abroad with their deep influence upon his development, were followed by a period of great activity in New York. His abilities were promptly recognized. Experiences in surgical teaching at that time apparently led him to a revaluation of methods of instruction, which had a profound effect upon the type of teaching which he later used at Johns Hopkins. The book is largely a chronicle of facts, rather than a presentation of material indicative of the various phases of development of the man. No doubt the reticence of Halsted, and the comparatively small number of those privileged to be called his intimates, greatly limited the sources of such material.

His personal characteristics are well portrayed. His quiet, unobtrusive, retiring manner cloaked a remarkable keenness of observation and a quick ability to appraise and judge. The inspiration

[1] LEHRBUCH DER CHIRURGIE. Dedicated to A. Von Eiselsberg. Edited by P. Clairmont, H. v. Haberer, W. Denk, E. Ranzi. Vols. I and II. Vienna: Julius Springer, 1930.

[2] EMERGENCY SURGERY. By Hamilton Bailey, F.R.C.S.(Eng.). Vol. I, Abdomen and Pelvis. New York: William Wood and Company, 1930.

[3] UEBER DAS PROBLEM DER BOESARTIGEN GESCHWUELSTE; EINE EXPERIMENTELLE UND THEORETISCHE UNTERSUCHUNG. 2d ed. By Prof. Dr. Lothar Heidenhain. Berlin: Julius Springer, 1930.

[4] WILLIAM STEWART HALSTED: SURGEON. By W. G. MacCallum. Introduction by Dr. W. H. Welch. Baltimore: The Johns Hopkins Press. London: Oxford University Press, 1930.

afforded by his appreciation of fundamentals in investigation and in the technique of surgery, stamps those trained by him, and the imprint he leaves affects their characters as well as their surgical ability.

Probably no book written at this time about Halsted can do more than indicate his great influence, and the high position in surgery which future judgment will accord him. His position is so pre-eminent that the fullest appreciation of him will come only with time. Many appreciate that Halsted, alone in the United States, has founded a distinctive school of surgery. Many men, now leaders in their own fields of surgery were selected, guided, and directed by "The Professor" and to him they largely owe their accomplishments. Often his gentle queries have stimulated in the minds of his associates or assistants, a train of thought which has culminated in a brilliant contribution to our surgical knowledge or has guided men to their life's work. Possibly some of those so stimulated have forgotten their debts.

MacCallum's work brings great pleasure to those who have felt Dr. Halsted's influence, and is a suitable companion to the two volumes of his "Surgical Papers." To those who felt his influence, Halsted represents the highest of surgical ideals. This story of his life can hardly fail to inspire others to do better surgery. H. C. N.

BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be granted as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

NEW AND NONOFFICIAL REMEDIES, 1931. Containing Descriptions of the Articles Which Stand Accepted by the Council on Pharmacy and Chemistry of the American Medical Association on January 1, 1931. Chicago: American Medical Association, 1931.

RASSEGNA INTERNAZIONALE DI CLINICA E TERAPIA. Scritti in Onore di Enrico Burci. Under the direction of Domenico Taddei. Naples: Rassegna Internazionale di Clinica E Terapia, 1930.

LES TROUBLES FONCTIONNELS DE L'APPAREIL GÉNITAL DE LA FEMME. By Gaston Cotte. 2d ed. Paris: Masson et Cie, 1931.

ABDOMINAL PAIN. By John Morley, Ch.M., F.R.C.S. With an introduction by J. S. B. Stopford, M.D., F.R.S. New York: William Wood & Company; Edinburgh: E. & S. Livingstone, 1931.

HANDBUCH DER ROENTGENKUNDE. Edited by Guido Holzknecht. Vol. iii. Roentgenuntersuchung und Strahlenbehandlung der Speiseroehre. By Dr. Josef Palugyay. Vienna: Julius Springer, 1931.

CLINICAL OBSERVATIONS ON THE SURGICAL PATHOLOGY OF BONE. By David M. Greig, M.B., C.M., F.R.C.S. (Edin.), F.R.S.E. Edinburgh and London: Oliver and Boyd, 1931.

ANNALS OF ROENTGENOLOGY; a Series of Monographic Atlases. Edited by James T. Case, M.D. Vol. vii. Urological Roentgenology. By Hugh H. Young, M.D., and Charles A. Waters, M.D. 2d rev. ed. New York: Paul B. Hoeber, Inc., 1931.

THE DOCTOR AND HIS INVESTMENTS; Financial Policy and Technique for the Physician. By Merryle Stanley Rukeyser, B.Lit., M.A. Philadelphia: P. Blakiston's Son & Co., Inc., 1931.

AMERICAN PHYSICIANS AND SURGEONS; a Biographical Directory of Practicing Members of the Medical Profession in the United States and Canada. Prepared by James Clark Fifield, Editor of The American Bar. Minneapolis: The Midwest Company, 1931.

PRACTICAL X-RAY TREATMENT. By Arthur W. Erskine, M.D. Saint Paul and Minneapolis: The Bruce Publishing Company, 1931.

THE RATIONAL TREATMENT OF VARICOSE VEINS AND VARICOCELE; With Notes on the Application of the Obliterative Method of Treatment of Other Conditions. By W. Turner Warwick, M.A., M.B.(Cantab.), F.R.C.S.(Eng.) London: Faber & Faber Ltd., 1931.

SCHMERZVERHUETUNG ZWOELF VORLESUNGEN. By Dr. Fritz Starlinger. Vienna: Julius Springer, 1931.

LES FOYERS AMYGDALIENS. By G. Worms and J. M. Le Mée. Paris: Imprimerie Chantenay, 1931.

ACCIDENT INJURIES; The Medico-Legal Aspects of Workmen's Compensation and Public Liability. By Henry H. Kessler, A.B., M.D., F.A.C.S., F.A.P.H.A. Philadelphia: Lea & Febiger, 1931.

MAYO CLINIC MONOGRAPHS. A Clinical Study of Addison's Disease. By Leonard G. Rowntree, M.D. and Albert M. Snell, M.D. Philadelphia and London: W. B. Saunders Company, 1931.

COLLECTED PAPERS OF THE MAYO CLINIC AND THE MAYO FOUNDATION. Edited by Mrs. Maud H. Mellish Wilson, Richard M. Hewitt, B.A., M.A., M.D. and Mildred A. Felker, B.S. Vol. xxii, 1930. Philadelphia and London: W. B. Saunders Company, 1931.

INJURIES AND SPORT; a General Guide for the Practitioner. By C. B. Heald, C.B.E., M.A., M.D.(Cantab.), M.R.C.P.(Lond.). London and New York: Oxford University Press, 1931.

MAYO CLINIC MONOGRAPHS. Proctoscopic Examination and the Treatment of Hemorrhoids and Anal Pruritus. By Louis A. Buie, B.A., M.D., F.A.C.S. Philadelphia and London: W. B. Saunders Company, 1931.

CLINICAL CONGRESS OF AMERICAN COLLEGE OF SURGEONS

C. JEFF MILLER, NEW ORLEANS, *President* ALLEN B. KANAVEL, CHICAGO, *President-Elect*
FRANKLIN H. MARTIN, *Director-General*

CHARLES GORDON HEYD, *Chairman, New York Committee*
JOHN E. JENNINGS, *Chairman, Brooklyn Committee*

PLANS FOR THE NEW YORK–BROOKLYN CLINICAL CONGRESS

UNDER the supervision of a representative committee of surgeons of New York and Brooklyn there is being prepared a program of clinics and demonstrations in the hospitals and medical schools for the twenty-first annual Clinical Congress of the American College of Surgeons, October 12th to 16th. The preliminary clinical program, which appeared in the June issue of this journal and which will be published in revised form in the September issue, will be further revised and amplified during the weeks preceding the Congress in order to present a more complete outline of the clinical work that will be demonstrated. The clinicians of greater New York are keenly interested in providing for the visiting surgeons a complete showing of the surgical activities of that great medical center, a program that will include all branches of surgery—general surgery, gynecology, obstetrics, orthopedics, urology, proctology, and surgery of the eye, ear, nose, throat, and mouth.

Clinics are scheduled for Monday afternoon, beginning at 2 o'clock, and for the mornings and afternoons of each of the four following days. One recalls that at three previous sessions in that city most attractive clinical programs were presented and we have the confident assurance of the committee on arrangements that in point of scientific interest this year's Congress will surpass previous sessions.

Wednesday has been designated as "Brooklyn-Long Island Day" and for that day the committee is preparing a special program of clinics in the hospitals of that borough which will include many interesting features.

A series of fracture clinics demonstrating modern methods in the treatment of fractures constitutes a special feature of the clinical program. The committee is arranging for a comprehensive showing at several of the larger hospitals of the methods employed and the results obtained in the treatment of fractures, which form so large a part of the surgical work in our large cities.

Among the important features of the clinical program will be demonstrations in the treatment of cancer by surgery, radium and X-ray; rehabilitation by surgery and physical therapy of patients injured in industrial accidents.

The real program of the Congress will be issued daily in the form of bulletins that give a complete, accurate, and detailed schedule of the clinics to be given at each of the hospitals. These bulletins will be posted at headquarters each afternoon for the following day and printed bulletins containing the same schedules will be distributed each morning.

EVENING MEETINGS

Programs for a series of five evening meetings are being prepared by the Executive Committee of the Congress. At the Presidential Meeting on Monday evening, following the introduction of distinguished guests from abroad and the inaugural address of the president-elect, Dr. Allen B. Kanavel, of Chicago, the John B. Murphy oration in surgery will be delivered by Mr. Arthur H. Burgess, M.B., F.R.C.S., Manchester, England, professor of clinical surgery in Victoria University, Manchester, England, and president of the British Medical Association.

The annual fracture oration will be delivered by Professor William Darrach, of Columbia University. His subject will be "Some Old Truths about Fractures."

Among the distinguished visitors from abroad is Sir Charles Gordon Watson, K.B.E., C.M.G.,

F.R.C.S., of London, England, who will speak on "Some Experiences in the Treatment of Carcinoma of the Rectum with Radium."

Other speakers at the evening meetings with the titles of their papers are: George W. Crile, M.D., Cleveland, "Technique and End-Results in Denervation of the Adrenal Glands"; Arthur M. Shipley, M.D., Baltimore, "The Operative Approach to the Heart and Pericardium"; Elliott C. Cutler, M.D., Cleveland, "The Present Status of Cardiac Surgery"; Ralph Pemberton, M.D., Philadelphia, "The Newer Concept of Chronic Arthritis"; William R. Cubbins, M.D., Chicago, "Repair of Knee Joint Injuries Received by a Lateral Impact of Extended Leg."

At the annual convocation of the Congress on Friday evening the 1931 class of candidates for fellowship in the College will be received. The presidential address will be delivered by Dr. Kanavel.

Special meetings of the sections on ophthalmology and otolaryngology of the New York Academy of Medicine have been arranged for Tuesday and Wednesday evenings at the Academy at which papers of interest to those who practice these specialties will be presented by a number of outstanding American ophthalmologists and otolaryngologists.

FEATURES OF THE PROGRAM

Important features of this year's Congress include a cancer symposium under the auspices of the Committee on the Treatment of Malignant Diseases on Thursday afternoon following the annual meeting and a session on Thursday forenoon devoted to a consideration of the essentials in the organization and administration of cancer clinics throughout the country under the guidance of the College.

An all-day conference on traumatic surgery under the auspices of the Board on Traumatic Surgery and Industrial Medicine is being arranged for Friday, at which leaders in industry and labor, representatives of indemnity companies, surgeons, and hospital administrators will discuss various phases of this important activity of the College. Dr. Frederic A. Besley, chairman of the Committee, will report on the work of the Committee in recent years, outlining its present and future activities in respect to the nation-wide survey of the medical and surgical facilities of our industries.

The newer surgical films, both sound and silent, including some in colors, will be exhibited daily at headquarters. An extensive program of film contributions will be presented, including the films that have been produced under the supervision of the Board on Medical Motion Picture Films of the American College of Surgeons.

HEADQUARTERS

General headquarters for the Clinical Congress will be established at the new Waldorf-Astoria Hotel, located on Park Avenue between 49th and 50th Streets. This magnificent new hotel, with more than 2,000 guest rooms, which is now nearing completion and will open early in the fall, affords unusual facilities for sessions of the Clinical Congress. The grand ballroom and other large rooms and foyers on the second floor of the hotel have been reserved for the exclusive use of the Congress, for scientific meetings, conferences, film exhibitions, registration and ticket bureaus, bulletin boards, executive offices, scientific and technical exhibitions, etc. All the comforts and facilities of the old Waldorf-Astoria, which had been headquarters on the occasion of three previous Congresses, will be found in the new hotel with many added attractions and conveniences.

Space has been reserved in the Astor Gallery, Jade Room, and other large rooms and foyers on the second floor of the hotel adjacent to the grand ballroom for the Technical Exhibition, in which will be represented the leading manufacturers of surgical instruments, X-ray apparatus, operating lights, hospital apparatus of all kinds, pharmaceuticals, publishers of medical books, etc.

HOSPITAL STANDARDIZATION CONFERENCE

For the fourteenth annual hospital conference, which opens at 9:30 on Monday morning in the grand ballroom of the Waldorf-Astoria, an interesting program of papers, round table conferences, and practical demonstrations that deal with problems related to the hospital standardization program of the College has been prepared. This program is planned to interest surgeons, hospital trustees, executives, and nurses, and an invitation to attend the conference is extended to all persons interested in the hospital field.

Monday—9:30 A.M.*–12:00* A.M.

Chairman's address. C. JEFF MILLER, M.D., New Orleans.
Ethics, Ideals, and Service as Applied to the Approved Hospital. ALLEN B. KANAVEL, M.D., Chicago.
Present Program of the American College of Surgeons. FRANKLIN H. MARTIN, M.D., Chicago.
Analysis of Findings from the 1931 Hospital Standardization Survey (illustrated). MALCOLM T. MACEACHERN, M.D., Chicago.
Program of the American College of Surgeons for the Care of the Ill and Injured in Industry. FREDERIC A. BESLEY, M.D., Waukegan, Ill.

Organizing a Service for the Diagnosis and Treatment of Cancer in an Approved Hospital (illustrated). BOWMAN C. CROWELL, M.D., Chicago.
Responsibility of the Fellows of the College in Promoting the Hospital Standardization Program. SOUTHGATE LEIGH, M.D., Norfolk, Va.
The Soul of the Hospital. REV. ALPHONSE M. SCHWITALLA, S.J., Ph.D., St. Louis.
Our Challenge: How Shall We Meet It? PAUL H. FESLER, Minneapolis.
General discussion opened by GEORGE W. CRILE, M.D., Cleveland.

2:00 P.M.–*5:00* P.M.

Significance of the Seemingly Insignificant Matters in Hospital Management. DONALD GUTHRIE, M.D., Sayre, Pa.
Importance of More Adequate Sterilization Processes in Hospitals. WALTER E. DANDY, M.D., Baltimore.
Present Status of Hospital Costs and Charges—Report of a Nation-Wide Survey. JOHN A. MCNAMARA, Chicago.
The Staff Conference Which Assures a Thorough Review of the Clinical Work and Maximum Benefit to the Medical Staff and Hospital (illustrated). ALTON W. OCHSNER, M.D., New Orleans.
Important Factors in Assuring Efficient Nursing Care of the Patient. JANET F. KORNGOLD, R.N., New Orleans.

Tuesday—9:30 A.M.–*12:00* A.M.

Open forum conducted by ROBERT JOLLY, Houston, Texas.
The Present Economic Depression in Hospitals—Increasing the Utilization of Hospital Facilities—Maintaining the Balance Between Economy and Efficiency. C. J. CUMMINGS, Tacoma, Wash.
Avoiding Pitfalls in Hospital Administration—Stop, Look, Listen! A. J. SWANSON, Toronto.
Administrative and Medical Problems Associated with the "Open" Hospital. FRANK J. WALTER, Denver.
What Shall We Do About Automobile Accidents?—Report of a Nation-Wide Survey. MATTHEW O. FOLEY, Chicago.

2:00 P.M.–*5:00* P.M.

Conference on Medical Social Service and Follow-Up: The General Organization and Scope of Social Work in Medical Institutions; A Plan for Efficient Follow-Up of Discharged Patients; Medical Social Work in Industrial Medicine and Traumatic Surgery; Medical Social Service as Applied to the Cancer Patient.

7:30 A.M.–*10:00* A.M.

Our Responsibility as Trustees. F. L. BRAMAN, Torrington, Conn.
Promoting a Better Understanding Between the Superintendent, Trustees, and Medical Staff. CHARLES F. NEERGAARD, Brooklyn.
By What Criteria Can the Trustees or Governing Body Judge the Efficiency of Their Institution? S. S. GOLDWATER, M.D., New York.
Factors to be Considered in the Cost of Medical Care from the Standpoint of the Hospital. WILLIAM H. WALSH, M.D., Chicago.
What Do Hospital Trustees Expect from Their Superintendent? J. ALLEN JACKSON, M.D., Danville, Penn.

Wednesday—9:30 A.M.–*12:00* A.M.

How Can Scientific Clinical Records Be Assured (illustrated). JAMES T. NIX, M.D., New Orleans.
A Check System for Current Case Records. DOROTHY GILMAN, Seattle, Wash.
A Plan for Making Group Studies of Diseases (illustrated). PAUL W. WILLITS, M.D., Grand Rapids, Mich.
A Complete System of Departmental Daily Reports Essential in Efficient Hospital Administration. WILLIAM I. LACY, Cleveland.
General discussion opened by THOMAS R. PONTON, M.D., Augusta, Ga.

2:00 P.M.–*3:30* P.M.

Round Table Conference—Medical and Nursing Problems. Conducted by R. C. BUERKI, M.D., Madison, Wis.
Round Table Conference—Administrative and Economic Problems. Conducted by ROBERT JOLLY, Houston, Texas.

Brooklyn—Thursday—9:30 A.M.–*12:00* A.M.

Demonstration and round table conferences conducted by MALCOLM T. MACEACHERN, M.D., Chicago; and ROBERT JOLLY, Houston, Texas: Procedure in admitting and discharging patients; organization and management of the case record department; nursing administration and service; operating room management and procedure; organization and management of the interne service.

2:00 P.M.–*4:00* P.M.

Demonstration and round table conference conducted by ROBERT JOLLY, Houston, Texas, and MALCOLM T. MACEACHERN, M.D., Chicago: Organization and management of the dietary department and food service; business methods in hospitals; management of the obstetrical department; handling of hospital visitors; public relations.

REDUCED RAILWAY FARES

The railways of the United States and Canada have authorized reduced fares on account of the New York session of the Clinical Congress so that the total fare for the round trip will be one and one-half the ordinary first-class one-way fare. To take advantage of the reduced rates it is necessary to pay the full one-way fare to New York, procuring from the ticket agent when purchasing ticket, a "convention certificate," which certificate is to be deposited at headquarters for the signature of the general manager of the Clinical Congress and the visé of a special agent of the railways. Upon presentation of a viséd certificate to the ticket agent in New York not later than October 20th a ticket for the return journey by the same route as traveled to New York may be purchased at one-half the one-way fare.

In the eastern, central, and southern states and eastern provinces of Canada tickets may be purchased between October 8th and 14th; in other sections of the United States and Canada at somewhat earlier dates. The return journey from New York must be begun not later than October 20th.

The reduction in fares does not apply to Pullman fares, nor to extra fares charged for passage

on certain trains. Local railroad ticket agents will supply detailed information with regard to dates of sale, rates, routes, etc. Stop-overs on both the going and return journeys may be had within certain limits.

Full fare must be paid from starting point to New York, and it is essential that a "convention certificate" be obtained from the agent from whom the ticket is purchased. These certificates are to be signed by the general manager of the Clinical Congress and viséd by a special railroad agent at Clinical Congress headquarters in New York on or before October 16th. No reduction in railroad fares can be secured except in compliance with the regulations outlined and within the dates specified. It is important to note that the return trip must be made by the same route as that used to New York and that the certificate must be deposited at headquarters during the meeting and return ticket purchased and used not later than October 20th.

An exception to the above arrangement is to be noted in the case of persons traveling from points in certain far western states and British Columbia, who will be able to purchase round trip summer excursion tickets which will be on sale up to and including October 15th with a final return limit of October 31st. The summer excursion fare is somewhat lower than the convention fare mentioned above, but is available only in certain of the far western states and British Columbia. Tickets sold at summer excursion rates permit traveling to New York via a direct route and returning via another direct route with liberal stop-over privileges.

LIMITED ATTENDANCE—ADVANCE REGISTRATION

Attendance at the New York-Brooklyn session will be limited to a number that can be comfortably accommodated at the clinics, the limit of attendance being based upon the result of a survey of the amphitheaters, operating rooms, and laboratories in the hospitals and medical schools to determine their capacity for accommodating visitors. Under this plan it will be necessary for those who wish to attend to register in advance.

Attendance at all clinics and demonstrations will be controlled by means of special clinic tickets, which plan provides an efficient means for the distribution of the visiting surgeons among the several clinics and insures against overcrowding, as the number of tickets issued for any clinic will be limited to the capacity of the room in which that clinic will be given.

A registration fee of $5.00 is required of each surgeon attending the annual Clinical Congress, such fees providing the funds with which to meet the expenses of the meeting. To each surgeon registering in advance a formal receipt for the registration fee is issued, which receipt is to be exchanged for a general admission card upon his registration at headquarters. This card, which is non-transferable, must be presented in order to secure clinic tickets and admission to the evening meetings.

NEW YORK HOTELS AND THEIR RATES

There are many first-class hotels in the Grand Central Terminal district within easy walking distance of the Waldorf-Astoria, the headquarters hotel. The following hotels are recommended by the Committee on Arrangements.

	Minimum Rates with Bath	
	Room Single	Double Room
Ambassador, Park Ave. and 51st St.	$7.00	$10.00
Barclay, 111 East 48th St.	6.00	10.00
Biltmore, Madison Ave. and 43rd St.	6.00	10.00
Chatham, Vanderbilt Ave. and 48th St.	5.00	8.00
Commodore, 42nd St. and Lexington Ave.	3.50	7.00
Gladstone, 114 East 52nd St.	4.00	6.00
Lexington, Lexington Ave. and 48th St.	3.50	6.00
Montclair, Lexington Ave. and 49th St.	3.00	5.00
New Weston, Madison Ave. and 50th St.	5.00	8.00
Park Lane, 299 Park Ave.	6.00	8.00
Ritz-Carlton, Madison Ave. and 46th St.	7.00	10.00
Roosevelt, Madison Ave. and 45th St.	5.00	7.00
Shelton, Lexington Ave. and 48th St.	4.00	6.00
Waldorf-Astoria, Park Ave. and 50th St.	7.00	10.00